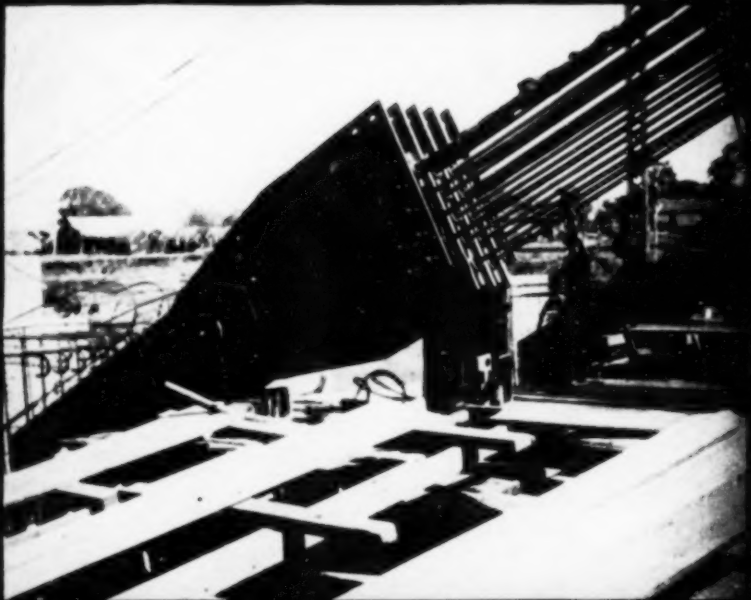
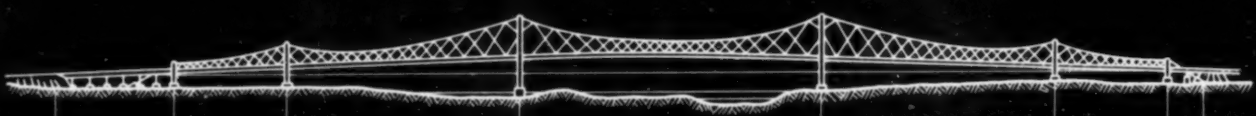
CIVIL ENGINEERING



AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

SAN MARCOS BRIDGE

Inclined suspenders stiffen unique five-span suspended structure on one of the byways of Central America. See symposium in this issue.



THE PENTAGON IN WASHINGTON rests on over 43,000 Raymond Piles varying in length from 16 to 58 feet, all of uniform bearing capacity.

CIVIL ENGINEERING, September 1954. Vol. 24, No. 9. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at ASCE Headquarters, 33 West 39th St., New York 18, N.Y. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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CIVIL ENGINEERING

SEPTEMBER 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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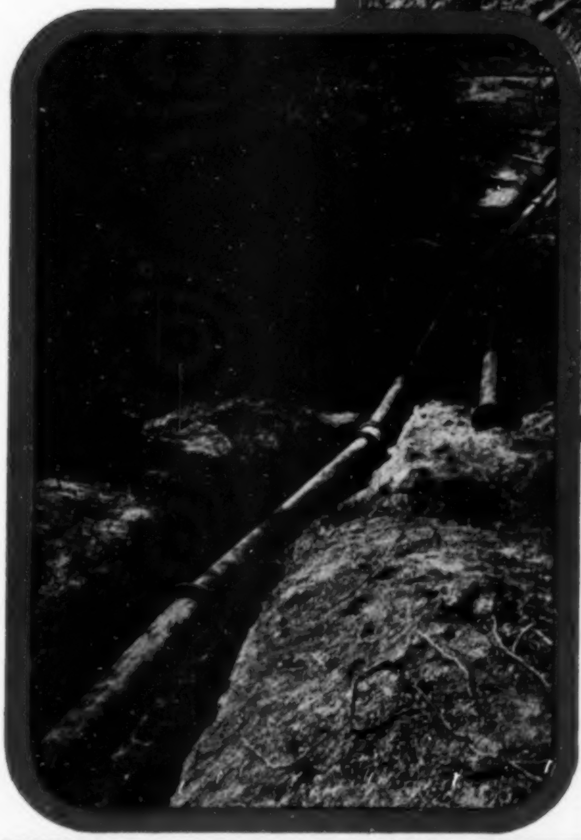


Wherever structural steel is used, it can be an ALLIED job

for instance

The new GILMORE STREET BRIDGE AT JACKSONVILLE, FLORIDA

5000 Tons of steel in this modern bridge were fabricated in the three Allied plants and erected, on location, by Allied skilled erecting crews. The nearly perfect facility with which a large bridge like this has moved along surely demonstrates the advantages to contractors, architects, and engineers of having a flexible organization like Allied to count on.

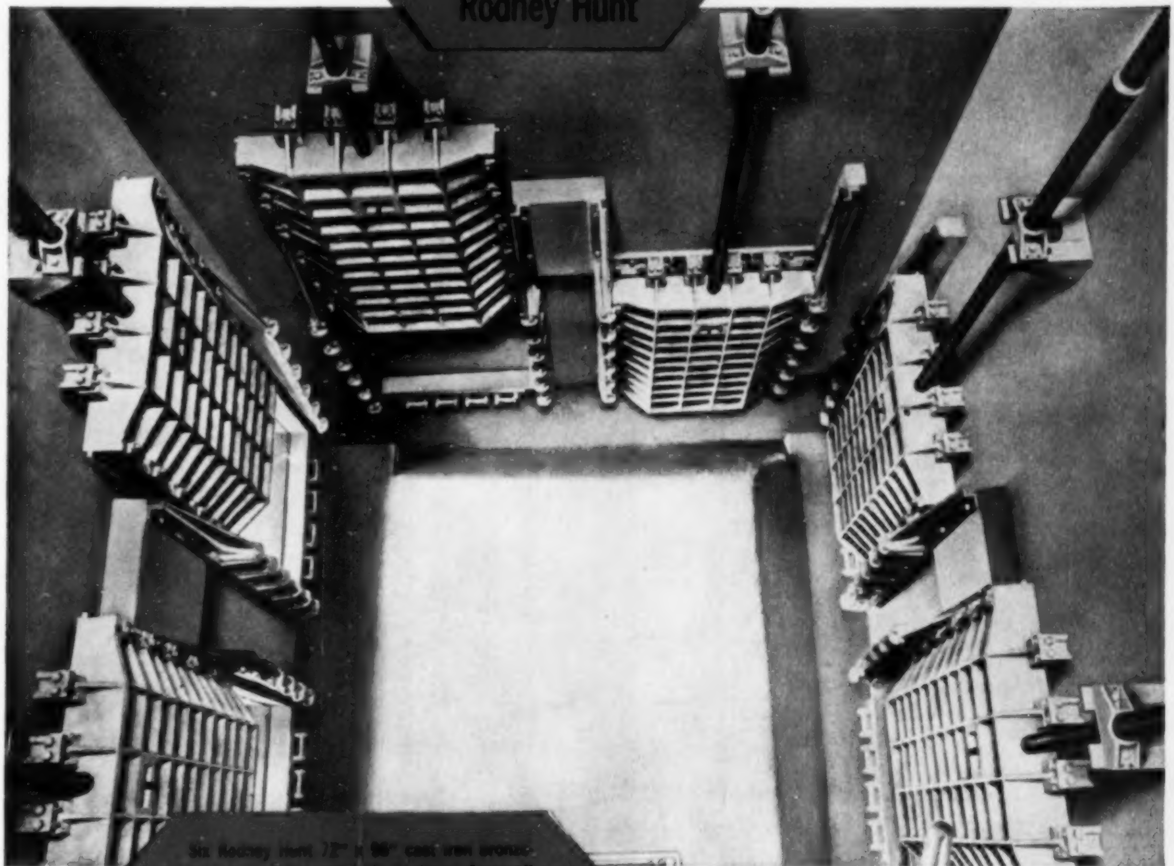
On any job, large or small, where fabricated structural steel is used, send your plans and specifications to us to be estimated.

Plants in Chicago, Ill., Hammond, Ind., and Clinton, Iowa.

Fabricators and erectors of structural steel for highway and railroad bridges; industrial, office, school, and government buildings; airport structures; harbor facilities.

When you must be SURE...

specify Rodney Hunt



Six Rodney Hunt 72" x 96" cast iron bronze-mounted sluice gates in a large four-well gate well chamber of a modern underground filtration plant. The two at left are inlets from the filter plant. Two in the middle act as inlet gates to the pit chamber. The two at right control the inlet passage to the main storage basin. All are built to withstand an operating pressure exceeding 50 feet.

When you must be SURE...

For Instance . . .

Think how important it was on this huge project to be sure of proved design, dependable operation and long life, *always* engineered into Rodney Hunt equipment. In addition to units shown, other Rodney Hunt sluice gates as big as 8' x 8' clear opening were installed in this underground reservoir and filter plant built for one of our greatest cities.

you CAN be sure with Rodney Hunt water control apparatus.

More than 2000 combinations of Sluice Gates and Hoists are described in our 232-page profusely illustrated catalog with valuable 28-page section on engineering data. Write *today* on your letterhead for Catalog WCA 952.

Manufacturing Engineers Since 1840

RODNEY HUNT®

RODNEY HUNT MACHINE CO.

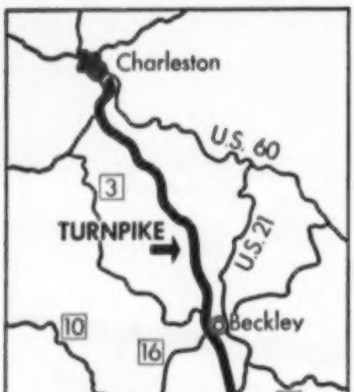
86 LAKE STREET, ORANGE, MASS., U. S. A.

Rodney Hunt agents in principal cities throughout the United States

West Virginia Turnpike: A Salute to Construction Skill

280 units of CAT* equipment helping contractors complete $100,000,000 job on schedule

A DW21 with No. 21 Scraper, owned by Oman Construction Co., is push loaded on a section of the turnpike near Beckley, W. Va.

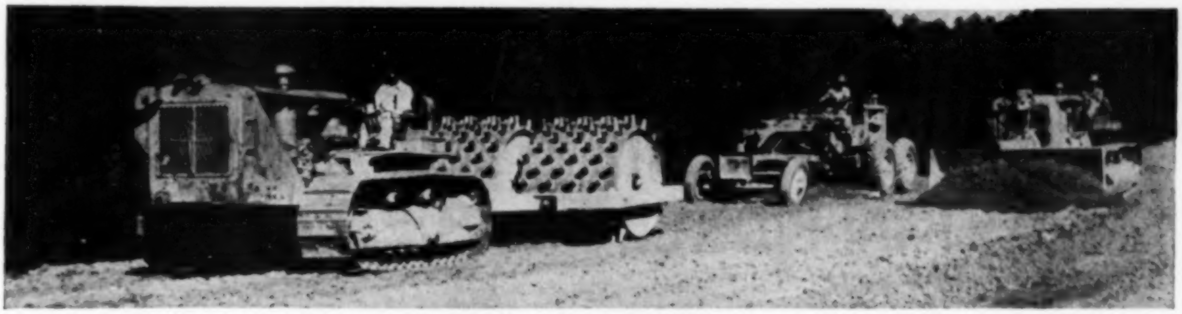


The 88-mile West Virginia Turnpike is expected to be ready for use this fall. Built through mountainous country for most of its length, the project has required moving some 31,000,000 cubic yards of earth for fill. During the spring and summer 3,000,000 tons of crushed rock has been spread in a 14-inch blanket, the full width of the grade, and 1,600,000 square yards of concrete paving have been laid.

This huge earthmoving job has been handled fast. During good weather a million cubic yards a week was the regular rate, and a high percentage of the material was rock.

With a maximum grade of 5 per cent, the new turnpike follows the sides of valleys throughout much of its length. The standard roadway is 50 feet wide, but many miles of extra-width grade have been built to take care of future dualization. Starting at 600 feet elevation in the Kanawha Valley near Charleston, the highway climbs to a maximum of 3200 feet at Flat Top, then descends to 2000 feet at Princeton.

It is expected to cut driving time by half, reducing over a thousand curves in the old road and shortening the distance by 32 miles.



Pulled by a Caterpillar Diesel D8 Tractor, this sheepsfoot tamper compacts earth on the Beckley section of the turnpike.

This Cat No. 12 Motor Grader works over new fill while a DW21 wheel Tractor speeds past for another load.

Caterpillar DW20 Tractors with No. 20 Scrapers are used by Clark, Farrell & H. N. Rogers to move earth near Pax, W. Va.

Two big Cat Diesel Electric Sets—a D386 and a D364—furnish all power for this crusher plant, operated by Central Materials Corp., near Kingston, W. Va.

Scores of contractors and subcontractors have shared in this accomplishment. And everywhere along the construction route the famous "highway yellow" of Caterpillar* heavy-duty machines has been in evidence. Included in the equipment are D8, D7 and D6 Tractors, DW20 and DW21 wheel-type Tractors, matching Caterpillar-built Bulldozers and Scrapers, Motor Graders, Cat Engines and Electric Sets powering shovels, compressors, crushers and light plants.

Experienced contractors know machines built by Caterpillar are moneymakers. They can be depended on to stay at work month after month, under all conditions, with a minimum of down time. And when service or parts are needed, they can be supplied by the nearby Caterpillar Dealer.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

Opening up the

HEAP LOADS IN A HURRY. One of Julian Construction Company's seven TD-24s push-loads a new INTERNATIONAL 2T-75 near Wauseon, Ohio. Julian has 1,000,000 cubic yards of dirt to move in sub-grading 7.2 miles of the Ohio Turnpike.

INTERNATIONAL TD-24 crawler tractors, preferred by contractors on toughest phases of Ohio Turnpike construction

An estimated 29,506,100 cubic yards of earth and rock is being excavated and an estimated 46,905,000 cubic yards of borrow and fill will be moved before the 241.1-mile Ohio Turnpike is completed.

A monumental project, requiring the most powerful, most dependable crawler tractors available.

All along the Ohio Turnpike, from the eastern terminus in Mahoning County to the western terminus in Williams County, INTERNATIONAL *TD-24 crawler tractors are taking over the toughest earthmoving jobs.*

With 155 drawbar horsepower, the INTERNATIONAL TD-24 can conquer any big job. And the durability of every TD-24 means less maintenance, downtime, and operating expense, more profit for the owner.

For more details on the new, complete line of INTERNATIONAL earthmoving equipment, including seven crawler tractors with 26 matched blades, two high-speed rubber-tired tractors with scrapers and bottom dump wagons, and four 4-wheeled scrapers, call your INTERNATIONAL Industrial Power Distributor today. While you're at it, arrange for a demonstration on *your* job of INTERNATIONAL equipment "sized" for *your* job.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

Ohio Turnpike

SMOOTHING A BRIDGE APPROACH. **Largest structures on the Ohio Turnpike are twin bridges north of Akron. Over 1,500,000 cubic yards will be moved by Wilco Builders, subcontractors, Brecksville, Ohio, with two TD-24s leading the way.**

DOES MORE THAN ITS SHARE FOR CENCI. **Subcontractor Nick Cenci and Sons, Inc., Columbus, Ohio, use an INTERNATIONAL TD-24 for the heaviest heaped-loading work. TD-24 recently push-loaded 450,000 yards of earth with no downtime.**

LOADS THEM OUT FOR LAUNDER AND PIERCE. **An INTERNATIONAL TD-24 hauls a loader on a 28 to 36-inch cut. Contract for this section is held jointly by Launder and Son, Inc., and The Pierce Construction Company, Toledo, Ohio.**

SPEEDS SOIL-STRIPPING FOR SMALLEY. **Approximately 3,600,000 cubic yards of earth will be moved by D. R. Smalley and Sons, Celina, Ohio. One of their three TD-24s is used to pull a loader on soil-stripping work near Milan, Ohio.**

HANDLES THE TOUGH ONES FOR HERKNER. **Extensive drainage is required through Summit and Cuyahoga Counties. Herkner Construction Company, Cleveland, uses the TD-24 shown here to handle excavation and drainage pipe placement.**

LOADING IN MAHONING COUNTY. **Two of D. W. Winkleman's five TD-24s complete fast cycles in spite of soggy going south of Youngstown. Roughly three-and-a-quarter million cubic yards will be moved on this contract.**

For every move in Earthmoving

See INTERNATIONAL
"Job-Phased*" equipment

INTERNATIONAL HARVESTER

INTERNATIONAL®

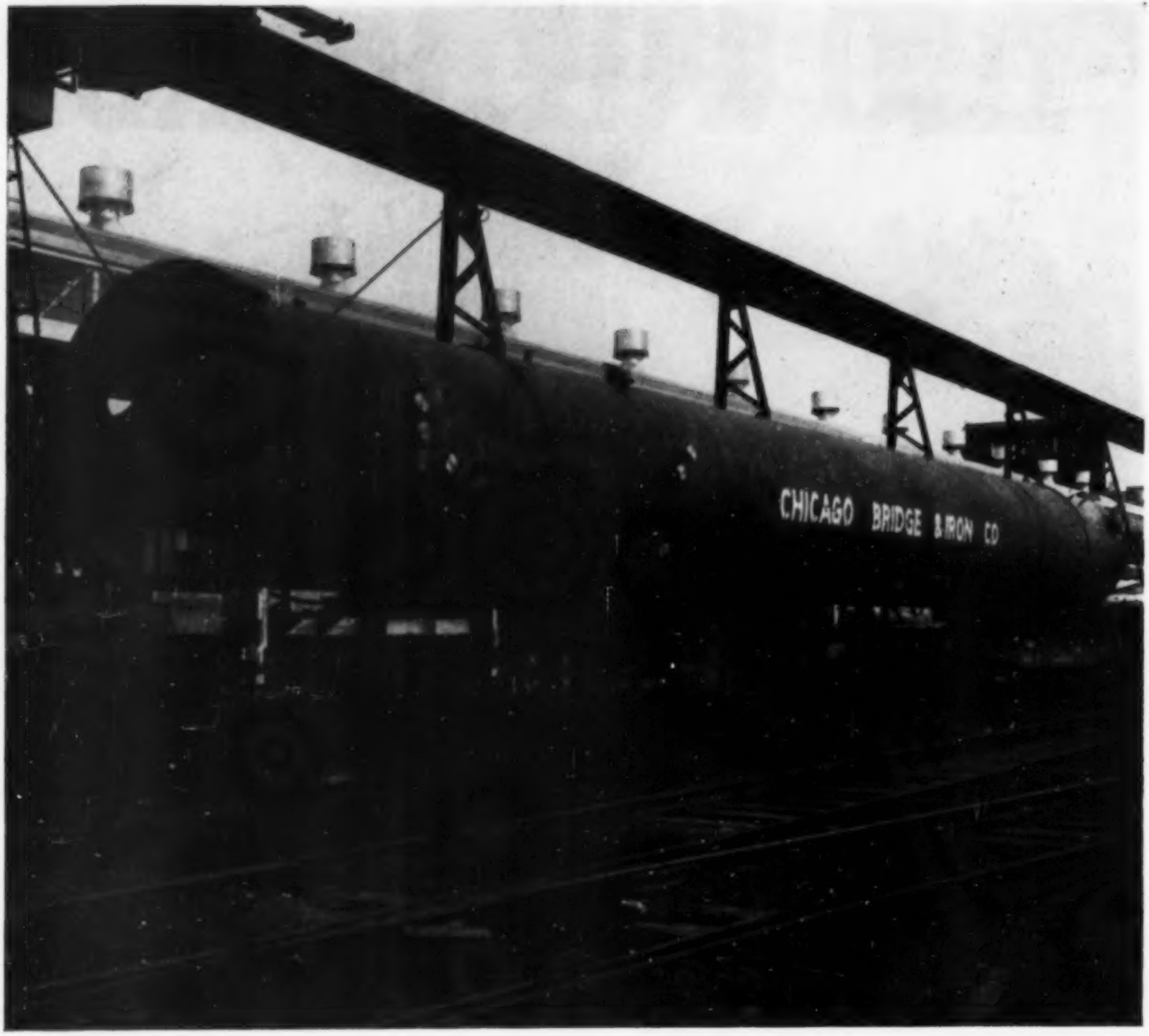
MAKES EVERY LOAD A PAYLOAD

*Phased Equipment—Machines designed and built to handle each major phase of earthmoving most efficiently and economically.


TD-6


T-6

SEVEN GREAT INTERNATIONAL CRAWLERS... EACH WITH MATCHED EQUIPMENT FOR EVERY JOB



CB&I Builds CO² Tower for Grace Chemical Company

The view above is of an 8-ft. diam. by 80-ft. CO² absorber tower built by Chicago Bridge & Iron Company under a contract from Foster Wheeler Corporation for the Grace Chemical Company's ammonia-utea plant at Woodstock, Tennessee.

In addition to the absorber tower, Chicago Bridge & Iron Company also furnished the following structures for the Grace Chemical Company's plant: 10-ft. diam. by 12-ft. tank made of aluminum; 54-ft. 9-in. diam. Hortonsphere designed for 75 lbs. per sq. in. working pressure; 160-ft. diam. by 30-ft. ammonia tank; 35-ft. diam. by 30-ft. fuel oil tank; 20-ft. diam. by 18-ft. water tank and 15-ft. diam. by 24-ft. pump tank.

The above structures are a cross section of the types of steel and special plate work structures that we are equipped to build. At four strategically located plants—Birmingham, Chicago, Salt Lake City and Greenville, Pa., we have the facilities to design, fabricate and build structures for a wide range of services.

We are equipped for X-raying welded joints, stress-relieving completed and partially completed structures and pickling and painting steel plate.

Write our nearest office for estimates or quotations on storage tanks, elevated water tanks, pressure storage vessels or any other type of steel plate work structure to meet your needs. There is no obligation on your part.

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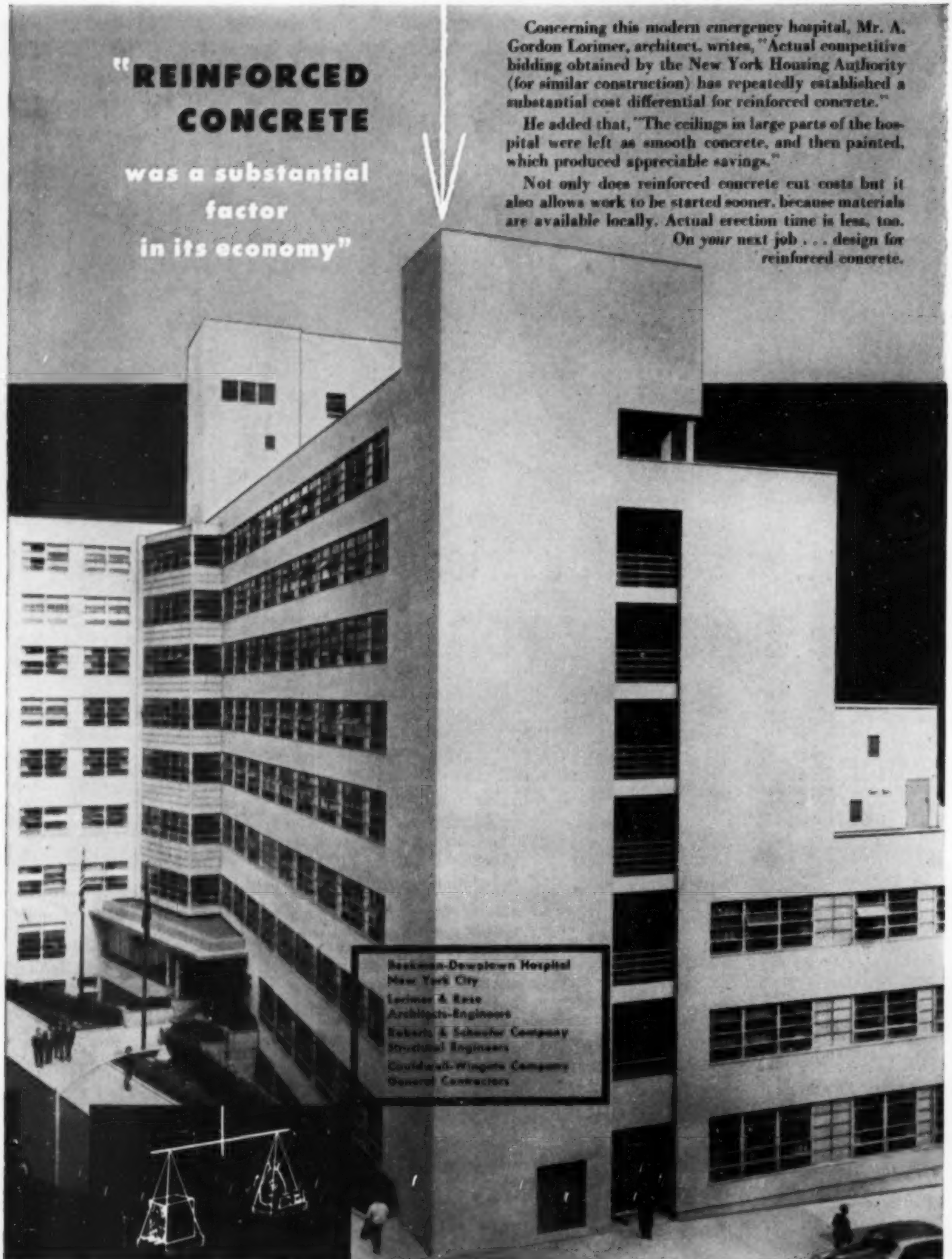
Chicago 4 .... 2199 McCormick Bldg.
Cleveland 15 .... 2263 Midland Bldg.
Detroit 26 .... 1541 Lafayette Bldg.
Houston 2 .... 2128 C & I Life Bldg.
Los Angeles 17. 1556 General Petroleum Bldg.
New York 6 .... 3395—165 Broadway Bldg.
Philadelphia 3 .. 1652—1700 Walnut St. Bldg.
Pittsburgh 19 .... 3210 Alcoa Bldg.
Salt Lake City 4 .. 509 West 17th South St.
San Francisco 4 .... 1584—200 Bush St.
Seattle 1 .... 1309 Henry Bldg.
Tulsa 3 .... 1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENN.


"REINFORCED CONCRETE
was a substantial factor in its economy"
Concerning this modern emergency hospital, Mr. A. Gordon Lorimer, architect, writes, "Actual competitive bidding obtained by the New York Housing Authority (for similar construction) has repeatedly established a substantial cost differential for reinforced concrete."
He added that, "The ceilings in large parts of the hospital were left as smooth concrete, and then painted, which produced appreciable savings."
Not only does reinforced concrete cut costs but it also allows work to be started sooner, because materials are available locally. Actual erection time is less, too.
On your next job . . . design for reinforced concrete.
Beekman-Downtown Hospital
New York City
Lorimer & Rose
Architects-Engineers
Structural Engineers
General Contractors


LOAD 'EM
FULL

NEWS OF ENGINEERS

Herbert Hoover, Honorary Member of ASCE, received the honorary degree of doctor of laws from the University of Iowa on August 10 during his eightieth birthday celebration at his birthplace, West Branch, Iowa. The degree, the former President's eightieth, was given "in grateful recognition of his more than threescore years of dedicated and continuing public service as a distinguished engineer and economist, renowned intellectual leader, courageous champion of world peace, faithful and trusted public official."

J. C. Dingwall has resigned as road design engineer for the Texas State Highway Department at Austin to become engineer-manager for the Texas Turnpike Authority.

B. C. Snow has accepted the position of chief engineer, Division of Water Resources, Inlets, and Coastal Waterways, North Carolina State Department of Conservation and Development, with headquarters at Raleigh. Since his retirement from active military service on December 31, 1952, Mr. Snow has been employed by Anheuser-Busch, Inc., of St. Louis, Mo., as owner's representative on construction of its $19,500,000 Los Angeles Brewery project.

A. R. LeFaucheur has been advanced from estimating engineer to director of public relations and advertising for the Turner Construction Co., of New York. He started with the company in 1947.

H. E. Bovay, Jr., consulting engineer of Houston, Tex., announces that his firm has opened an office in Spokane, Wash., which will offer professional service in civil, structural, industrial, mechanical, and electrical engineering in the Northwest. The new office will be located in the Spokane and Eastern Building.

D. J. Bleifuss, consulting engineer of Atherton, Calif., is now consultant on hydraulic structures for the St. Louis firm of Sverdrup & Parcel. Mr. Bleifuss resigned as vice-president and director of engineering for the International Engineering Co., San Francisco, in 1953 to enter private practice.

Manuel Jose Asensio, Major General, U. S. Air Force, who has been serving as director of the budget for the Comptrollers' Office at the U.S.A.F. Headquarters in Washington, D.C., since 1950, has been appointed vice-commander of the Continental Air Command, with headquarters at the Mitchell Air Force Base, New York.

Louis R. Douglass, who retired in March as director of power for the Bureau of Reclamation's Boulder Canyon Project, recently received the Department of Interior's Distinguished Service Award from Secretary Douglas McKay. With the Bureau of Reclamation for 21 years, Mr. Douglass was in immediate charge of Hoover Dam and power plant from 1950 until his retirement. He was an authority on the Davis Dam and power plant, having handled a major part of the administrative and engineering responsibilities on this development, and was author of a CIVIL ENGINEERING article on it (January 1947, p. 14). Mr. Douglass is currently a member of the U.S. Committee on Large Dams, national committee of the U.S. Commission on Large Dams of the World Power Conference.

Louis R. Douglass

Clarence Decatur Howe, Minister of Trade and Commerce and Defense Production for the government of Canada, has been awarded the Daniel Guggenheim Medal for 1954. He was cited for "initiating and organizing commercial air routes and services, promoting aeronautical research, development and production of aircraft and engines, and advancing the art of aeronautics."

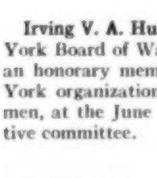
Frank R. Sherman has joined the Architects–Engineers, Spanish Bases—a joint venture with the firms of Shaw Metz & Dolio, Metcalf & Eddy, Frederic R. Harris, Inc., and Pereira & Luckman, participating—at Madrid, Spain as deputy project manager. Mr. Sherman was previously assistant general manager for Skidmore, Owings & Merrill on an assignment in Okinawa.

John S. Cotton, consulting engineer, is now located at 24 Evergreen Drive, Kentfield, Calif. He was formerly in San Anselmo, Calif.

Irving V. A. Huie, president of the New York Board of Water Supply, was elected an honorary member of the Moles, New York organization of heavy construction men, at the June 8 meeting of the executive committee.

Hal W. Hunt, secretary of the Construction Division of ASCE and resident engineer for Frederic R. Harris, Inc., New York consulting engineers, is now in Spain with Architects–Engineers, Spanish Bases—a joint venture in which Frederic R. Harris, Inc., is participating. Because of Mr. Hunt's absence from the country his post as secretary of the Construction Division will be filled by **William H. Quirk,** editor of *Contractors and Engineers,* who will handle Division correspondence from 470 Fourth Ave., New York 16, N.Y.

Raleigh W. Gamble has been named district engineer of the Asphalt Institute for the states of Illinois and Wisconsin, with headquarters at 11 South LaSalle St., Chicago. Mr. Gamble recently retired as superintendent of the Bureau of Street Construction and Repairs of the City of Milwaukee after thirty years of municipal service. In addition to his duties as superintendent, he has been director of expressways for the past four years. Mr. Gamble served as Director of ASCE from 1944 to 1946.



Raleigh W. Gamble

(*Continued on page 25*)

News of Engineers

(*Continued from page 23*)

Albert C. Smith has been appointed an associate editor of *Construction Methods and Equipment*, a McGraw-Hill publication, effective August 1. A civil engineering graduate of the Newark College of Engineering, Mr. Smith has been a field editor with *Contractors and Engineers* for the past three years.

E. T. Larsen has been named a vice-president of the Henry J. Kaiser Co., with headquarters in Oakland, Calif. As manager of engineering, he will be responsible for all engineering activities for Kaiser Engineers, a division of the parent firm. Mr. Larsen has been with the company since 1941.

Irwin B. Hosig recently retired as engineer with the U.S. Bureau of Reclamation, at Denver, Colo., following 49 years of service with that agency.

Charles H. Jennings has been transferred from the office of the Department of Public Works of the Navy, Washington, D.C., to the Sanitary Engineering Division of the District of Columbia, where he is serving as assistant chief mechanical superintendent of sewer operations.

Brig. Gen. Herbert D. Vogel, a specialist in water problems and ASCE Freeman Scholar in the early thirties, has been appointed chairman of the Tennessee Valley Authority by President Eisenhower. General Vogel, who is retiring from the Army Corps of Engineers after thirty years of service, is credited with the introduction of large-scale hydraulic engineering into this country. He was active in developing the Waterways Experiment Station at Vicksburg, has been the No. 2 engineer in the Panama Canal Zone, served in the South Pacific in the war, and is currently division engineer for the Southwest Division, with headquarters at Dallas. He is chairman of the Arkansas-White-Red River Basins Inter-Agency Committee. His term with the TVA, which has been confirmed by the Senate, is for nine years.

Herbert D. Vogel

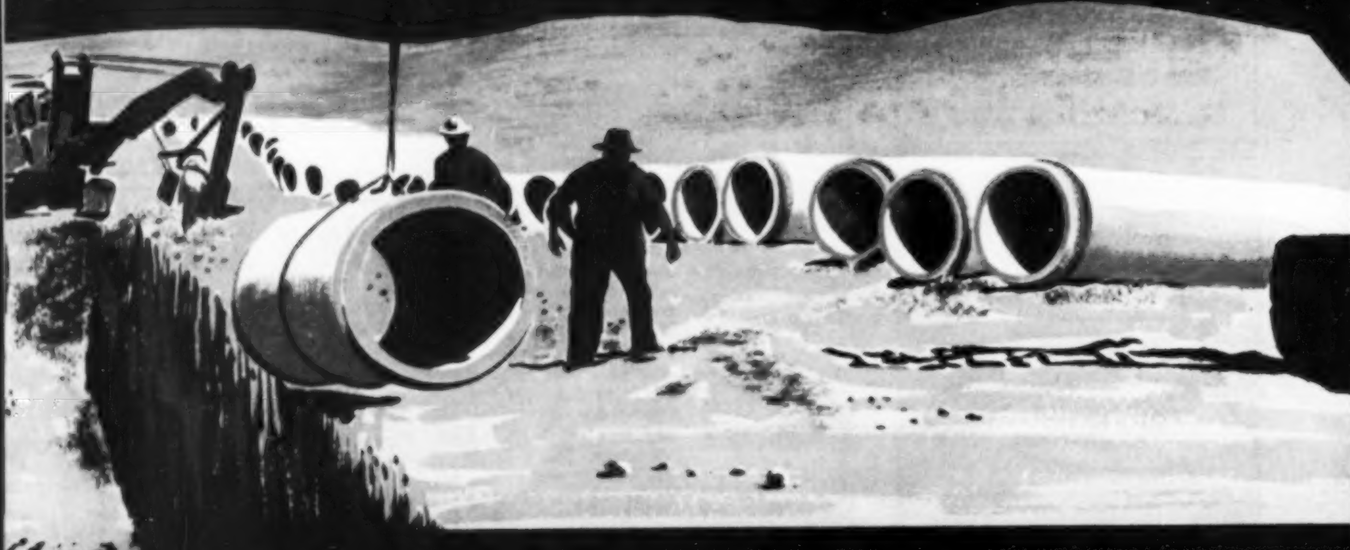
George L. Curtis was recently promoted from the position of chief engineer for the United Concrete Pipe Corp., at Baldwin Park, Calif., to vice-president of engineering. He has been associated with the firm since 1946.

Robert E. James was recently appointed city engineer of San Fernando, Calif. Formerly Mr. James was an associate civil engineer in the Burbank engineering department.

(*Continued on page 27*)

Reduce pipeline costs...

WITH EASIER, FASTER INSTALLATION OF AMERICAN'S REINFORCED CONCRETE PRESSURE PIPE



Excavation costs are lower. No need for bell-holes or excessive trench width. Flexible joints allow for minor changes in grade or alignment... offer protection against normal earth settlement.

Contractors can use standard equipment and semi-skilled labor to lay reinforced concrete pipe. Joint closure is simple and economical. Rubber gasket joints provide a safe, positive closure and eliminate costly welding or caulking.

Immediate backfilling is recommended and eliminates open trench hazards and costly, worrisome traffic problems.

You can realize these savings in installation costs and substantially reduce over-all pipe-line costs.

At the same time, the superior design, materials and workmanship which reflect American's 45 years of specialized experience in this field assure you of highest quality and maximum performance.

Write or call today for complete information.

PIPE AND CONSTRUCTION CO.

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous pipe lines

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Oakland • San Diego • Portland, Oregon

News of Engineers

(Continued from page 25)

Myron H. Cutler has been appointed chief structural engineer of the Stone & Webster Engineering Corp., Boston, responsible for administration of the work of its structural division. He succeeds **Ernest A. Dockstader,** who has been named consulting engineer to the organization.

Reginald C. Price, water resources expert on leave from the Department of the Interior, has joined the UN's Economic Commission for Asia and the Far East at Bangkok, Thailand. Mr. Price will be concerned, particularly, with the planning and economic analysis of water development projects in the region, and will cooperate on the preparation of a manual of multi-purpose river basin development projects, to be published by ESCAFE's Bureau of Flood Control and Water Resources Development. Until recently Mr. Price was director of the Water and Power Division of the Department of the Interior. In a news item on Mr. Price's new work in the July issue (page 29) it was incorrectly stated that he was on leave from the Federal Power Commission.

Lowell J. Stephenson, construction engineer for Porter-Urquhart Associated, was recently transferred from the company's San Francisco office to Fremont, Ohio, as engineering manager to its construction contracts for the Ohio Turnpike Commisssion. Prior to his San Francisco assignment, Mr. Stephenson was resident engineer on his company's joint-venture project for the New Jersey Turnpike and project engineer for its Garden State Parkway work.

William F. Trigeiro, former city engineer of Atwater, Calif., and more recently assistant city engineer of Salinas, has been appointed assistant city engineer of Santa Clara, Calif.

Lacey V. Murrow, former executive director of Competitive Transportation Research for the Association of American Railroads, in Washington, D.C., is now in charge of the Washington office of Transportation Consultants, Inc., a firm of consulting engineers.

Ralph Tudor has resigned as Undersecretary of the Interior, effective September 1, to return to private practice in San Francisco as president of the Tudor Engineering Co. The appointment of **Clarence A. Davis,** solicitor for the Department of the Interior and former attorney general of Nebraska, to take Mr. Tudor's place has been confirmed by the Senate.

William J. Gross, city engineering aid in the office of the service director of Toledo, Ohio, was recently named secretary and administrative assistant to the city manager. Replacing Mr. Gross in the service director's office is **David C. Colony,** a member of the city engineering division.

Nathan Grout, structural engineer of Tampa, Fla., has added an architect to his staff for the convenience of his clients. He also has new and expanded headquarters at 3209 Tampa Street.

Virgil E. Gunlock, commissioner of public works for the city of Chicago, has assumed the additional responsibilities of chairman of the Chicago Transit Authority, succeeding **Ralph Budd.**

Elmer M. Ward has been appointed assistant director of the Highway Research Board. Mr. Ward has been with the Board since 1946—as engineer of materials and construction since 1949. His headquarters will continue to be in Washington, D.C.

James M. Gere has been appointed assistant professor of civil engineering at Stanford University, where he will teach courses in structural engineering. Dr. Gere was formerly a research associate at Rensselaer Polytechnic Institute, where

he worked on the underground explosion test program for the Corps of Engineers.

M. H. Greaser has been elected president of the American Dredging Co., with headquarters in Philadelphia.

Frederick C. Gardner has advanced from executive vice-president to president and chief executive officer of Ebasco Services, Inc., New York, N.Y. Mr. Gardner has been working continuously for Ebasco or its associated companies since his graduation from North Carolina State College in 1917, when he became a draftsman on investigation of hydroelectric power sites in North Carolina. He came to the New York office in 1921, became engineering manager in 1943, vice president in 1945, and executive vice-president in 1952.

Frederick C. Gardner

William W. Brewer resigned July 23 as resident partner in Dames & Moore's San Francisco office. **William W. Moore,** senior partner, will continue to direct the activities of the San Francisco office. Mr. Moore, who has been associated with Dames & Moore since its formation in 1938, established its San Francisco office in 1941.

George M. Garrett, deputy state engineer for the Texas State Highway Department, at Austin, has retired after 30 years of service. Recently Mr. Garrett was engineer-manager for the Fort Worth Expressway System.

R. Duane Monical and **Clair K. Wolverton** announce the formation of a partnership under the firm name of Monical and Wolverton, consulting engineers with offices at 203 Guaranty Building, Indianapolis, Ind. Both have been associated with Pierce & Gruber, of Indianapolis, as structural designers. They will specialize in civil and structural engineering.

Wolf Sefton has accepted the position of chief engineer and director of W. V. Zinn & Associates, Ltd., consulting engineers of Toronto. Until recently senior engineer with the C.D. Howe Co., Ltd., of Montreal, Mr. Sefton played a prominent part in the design and construction of the docks and ore-handling facilities near Seven Islands, Quebec.

James B. Thompson, until recently engineer in the home office of Dames & Moore in Los Angeles, is now resident partner in the company's newly opened Chicago office. **Benjamin S. Persons,** formerly personnel manager for the Los Angeles office, is assistant to the resident partner in Chicago. The address of the Chicago office is 53 West Jackson Blvd.

AN INTEGRATED PRODUCER IS A SUPPLIER YOU CAN RELY UPON

United States Pipe and Foundry Company is a wholly integrated producer of cast iron pressure pipe—from our mines and blast furnaces to our strategically located pipe plants.

This should be of major interest to a pipe buyer since it means:
(1) complete independence of action in supplying your needs as we produce our own raw materials,
(2) greater assurance of continuity of service at all times, and
(3) undivided control of quality at every step in pipe production from the ground up.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to *our own* quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U.S. cast iron PIPE

Ore and Coal Mines

Coke Ovens

Blast Furnaces

Pipe Plants

U. S. PIPE & FOUNDRY COMPANY

GENERAL OFFICES: BIRMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.

AUSTIN-WESTERN HYDRAULIC CRANE

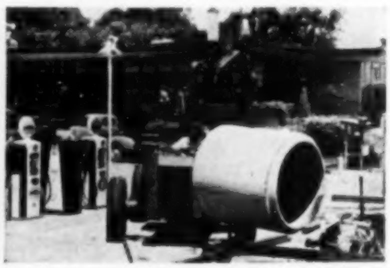
That's what I call a LIVE BOOM

. . . as you will agree, when you see this most versatile of all mobile cranes in action. During the entire pickup—carry—placement cycle, the boom is completely "alive," responds instantly to the operator's every demand; gets the job done with maximum ease and speed.

All tractor models have 4-wheel steer for maneuvering in close quarters; some have 4-wheel drive for maximum tractive effort. Boom lengths range from 18 to 35 feet. Outriggers may be had, if wanted. Usefulness is increased by such optional equipment as magnet and winch, and either clamshell or orange peel bucket.

CLOSE QUARTERS. Telescopic boom reaches up and over in an oil refinery.

SEWER EXCAVATION. Six men and one Hydraulic Crane replace 27 men and three slow-moving cranes.



SETTING PIPE. One of many uses found for the Hydraulic Crane by this contractor.

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do you know that

Detailed costs of a new Engineering Societies Center Building are being made? The basic facts needed to determine the best type of building and its location are being studied by a task committee of the UET Real Estate Committee that is expected to report to the Committee of Five Presidents (July issue, page 68) early in September.

Ground was broken for the St. Lawrence Power Project on August 10, just 418 years to the day after Jacques Cartier discovered the river? Annual output of the $600,000,000 project will be 12,600,000,000 kwhr to be shared equally by the United States and Canada.

EJC is initiating a program to aid in peacetime atomic developments? To assure best industrial use of atomic products and help solve other peacetime nuclear engineering problems, Engineers Joint Council will sponsor an atomic energy congress early next year.

Huge platforms will be set up in the Atlantic for our radar defense? A series of man-made islands—an adaptation of the Texas Tower used for oil-well rigs in the Gulf of Mexico—will soon be anchored in the Atlantic between Virginia and Newfoundland to house the equipment and personnel needed for our radar protection. This Air Force project is described on page 88.

The design of thin-shell structures can be simplified by using ASCE Manual No. 31, "Design of Cylindrical Concrete Shell Roofs"? Copies may be ordered from Society Headquarters at $2.50 (Members' price) and $5.00 (to others).

Some $4,000,000 worth of equipment has been assembled for the construction of the 33 reinforced concrete piers of the Mackinac Straits Bridge? The contract for the substructure of the long-debated project is held by the Merritt, Chapman & Scott Corp. for $25,735,000.

The building boom looks solid? The Chamber of Commerce of the United States predicts that, with building contracts awarded during the first half of the year 17 percent above the rate for the same period last year, when an all-time high was recorded, the construction boom will last at least through 1954.

Sea water and coral aggregate are being used to make good reinforced concrete? In the October issue D. Lee Narver will present results of seven years' experience with coral concrete on Bikini and Eniwetok.

A former Freeman Fellow has been appointed chairman of the TVA? This important post goes to Brig. Gen. Herbert D. Vogel, M.ASCE, who is retiring from the Army after 30 years of service (page 25).

The Air Force is to have a training academy on equal footing with West Point and Annapolis? Construction of the $126,000,000 project, to be located at Colorado Springs, Colo., will begin in 1955. Skidmore, Owings & Merrill, of Chicago, will be the architects. Associated with them are three engineering firms—Syska & Hennessy and Moran, Proctor, Mueser & Rutledge, of New York, and Robert & Co., of Atlanta.

A "cable-truss" type of suspension bridge is in successful service? A multiple-span highway bridge in El Salvador, called the San Marcos Bridge, is the first full-scale example of this pioneering design. The project is presented by five engineers on the work (beginning on page 40).

The world's largest aluminum smelter has begun operation? On August 3 the first ingot was poured at the Aluminum Company of Canada's new smelter at Kitimat in the wilds of British Columbia. Construction of the giant plant, which will have an ultimate annual output of 550,000 tons of aluminum, was described by W. G. Huber in articles in the November 1952 and February and June 1953 issues.

Collective bargaining continues to menace the engineering field? Charles W. Yoder, vice-chairman of the ASCE Committee on Employment Conditions, analyzes the factors—mainly union pressure and economic pressure—that permit collective bargaining to make inroads in such professions as engineering.

Annual ASCE honors have gone to sixteen Members? Biographies of our three new Honorary Members and thirteen prize winners are given in the Society News section.

On the Beam

Massachusetts Builds Handsome Bridges with Precision-Precast, Prestressed 'Incor' Concrete Beams—Spans up to 65 feet

Scotland Road Bridge: 24 beams of 65-ft. span, prestressed by Roebling method.

● In an area enshrined in yesterday's history, Massachusetts is today making construction history, with precast, prestressed bridges built with post-tensioned beams, spans up to 65 ft.

MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS has to date built seven prestressed bridges, using various methods of tensioning, as part of a far-seeing program. Four bridges, shown here, on Newbury-Newburyport Relocation of Route 1, have I-shape cross section, with depth-to-span ratios of 1:17 to 1:21. Beams are spaced 4½ ft. apart, decks cast in place. Overall lengths vary, but distance between diaphragms is constant.

Beams were fabricated by NEW ENGLAND CONCRETE PIPE CORPORATION under carefully controlled conditions, in an outdoor casting yard. Using 'Incor'* 24-Hour Cement, concrete was steam-cured, and even in cold weather, forms were stripped in less than 24 hours, and initial tension of 50 tons applied. The 4000 psi specified for full prestressing was attained in 24 to 27 hours.

Outstanding projects such as these re-emphasize the coming of age of prestressing, for important economies in concrete and reinforcing steel, as well as in erection. There is an inbuilt safety factor, too: During fabrication, members are subjected to greater loads than they take in the field. And concrete never has to be painted.

Designed for the material and method, not as a substitute for something else . . . with members cast to closest tolerances for fast erection . . . mass produced under controlled conditions—result, beautiful, enduring, economical structures to serve a highway-hungry nation.

*Reg. U. S. Pat. Off.

Hale Street Bridge: 18 beams of 64-ft. span, prestressed by Freyssinet method.

Design and Supervision
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
JOHN A. VOLPE, Commissioner
JOHN RUNDLETT, Bridge Engineer **H. G. GRAY**, Chief Engineer

General Contractor: **A. V. TAURASI CO.**, Boston

Beams Fabricated by: **NEW ENGLAND CONCRETE PIPE CORPORATION**
Newton Upper Falls, Mass.

Storey Avenue Bridge: 36 beams of 58-ft. span, prestressed by Lee-McCall method.

Pine Hill Road Bridge: 20 beams of 59-ft. span, prestressed by Prestressed Concrete Corp. method.

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CIVIL ENGINEERING SEPTEMBER 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Exterior wall construction is here seen virtually completed, except for glazing. Four floors for club use are above setback at 17th floor level.

J. A. CROWLEY, A.M. ASCE

Chief Structural Engineer

Technic Engineering Company, Dallas, Tex.

Denver Club Building incorporates latest structural features

There is always reluctance on the part of the local citizenry to abandon and remove a historical landmark, even though it is to be replaced by a new and modern structure offering greatly improved facilities and increased valuation. The razing of the 64-year-old Denver Club structure was no exception. However, the new Denver Club Building, only one of several new buildings contemplated or actually under construction in Denver, will provide a substantial amount of much-needed office space in the city and will give members of the Denver Club new and unexcelled facilities, as well as an unsurpassed view of the Rocky Mountains seen against the skyline in the distance.

The new Denver Club Building is a 23-story combination office and club structure situated in the heart of downtown Denver and occupying a ground area of 15,625 sq ft (Fig. 1). The new building comprises one full basement, 16 floors of general office space, 4 floors of club facilities, 2 floors of mechanical and electrical equipment, surmounted by a penthouse apartment. The total height of the building above sidewalk grade is 280 ft. In conformity with the

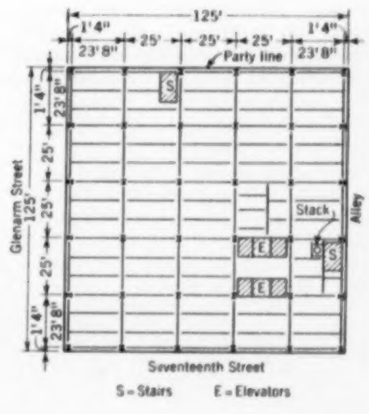


FIG. 1. Typical floor of Denver Club Building, for which framing plan is given here, covers about 15,625 sq ft. There are 16 floors of general office space, 4 of club facilities, 2 for mechanical and electrical equipment, plus penthouse apartment.

Building Code of the City and County of Denver, setbacks were provided at the 17th floor on three sides of the building. The fourth side, being adjacent to an alley, was permitted to extend the full height along the building line.

Shortly after the owner's decision to proceed with the project, and before demolition of the old club building, a number of borings were made around the periphery of that structure, employing auger-type equipment through holes in the boundary sidewalks and alley pavement. Materials encountered, from the surface to an average depth of 36 ft, consisted of sands, gravels, and silts deposited in the ancient course of the South Platte River. Free water was found at a depth of approximately 36 ft below the surrounding grade, at which depth a relatively thin stratum of weathered shale overlies the Denver formation, so-called—highly lenticular, alternately bedded strata of sandstones and shales. Two of the borings were extended 50 ft into the Denver formation by means of hydraulic rotary drilling equipment and the cores used for laboratory determinations of shear, bearing, and settlement characteristics. From these data a maximum load carrying capacity of 20,000 psf was established for design purposes.

Bell-bottomed, drilled piers chosen

Preliminary design and cost analysis indicated bell-bottomed, drilled piers to be the most economical solution to the foundation problem, and design calculations proceeded accordingly. Each of the 36 structural columns is supported by one such drilled pier carrying a maximum load of 3,000 kips. In general, foundation loads varied from 660 to 1,800 kips, except for elevator and utility core columns, which varied between 2,000 and 3,000 kips. Pier diameters varied from 36 to 54 in., and vertical reinforcement was standardized using No. 11 bars with $^3/_8$ and $^1/_2$-in. spirals. Piers were belled out at the bottom to diameters varying from 7 to 14 ft, with conical sides sloping at 60 deg from the horizontal. The depth of the bells obviously varied, since the Denver formation is not found at a uniform depth, and the bells were extended for their full depth into this formation. Pier shafts averaged 21 ft deep below basement grade, and the bells extended from 4 to 10 ft deeper.

Before foundation excavation was started, steel sheetpiling was driven several feet outside the building line on the alley side and along a portion of the party line. Timber sheeting and shoring were provided along the two street lines, and the entire area was excavated to the level of the basement slab subgrade. This excavation revealed a point of interest—that the foundations of the adjoining building were not built according to plans, and therefore had to be underpinned. Following this excavation procedure, the entire area was made available to the drilling subcontractor.

Drilling for the foundation piers was accomplished with a large earth auger mounted on a special drill rig and operating within a removable steel casing. For the most part, excavated material was removed on the auger blades and cast off to the sides of the holes, whence it was loaded into trucks for ultimate disposal. Belling was performed by laborers using jackhammers and clay spades, and the broken shale was removed with buckets elevated by portable winches. Reinforcing-steel cages were installed in the holes after dewatering and the steel casing extracted as the concrete was placed. To keep the pier bells from encroaching on abutting property, centers of piers were established 3 ft 4 in. inside the party line, and bells were made rectangular in shape.

To maintain a constant setback distance to exterior column center-lines, and to eliminate the necessity of using large, rectangular base plates, intermediate pilasters on the party-line wall were designed as composite columns utilizing extensions to first-tier steel columns as metal cores. Column loads were transmitted by bond on the metal core through the spirally reinforced concrete pilaster to strap beams connecting the first two lines of piers. The use of 4,000-psi concrete for the entire foundation, except the basement slab, resulted in smaller structural elements and effected considerable economy.

Metal-glass facade

Exterior wall construction on the party and alley lines is of conventional face brick with lightweight concrete back-up block, as dictated by the City and County of Denver Building Code.

Metal-glass façading on the street lines consists of an aluminum insulated sandwich panel in the spandrel area (Fig. 2), and the Browne folding-flue, aluminum window panel. Spandrel panels are of fluted Alumitex aluminum, laminated with $1^1/_2$ in. of rigid glass-fiber insulation and aluminum foil, giving a heat transmission factor of 0.12. Sash panels are glazed with $^1/_4$-in. green tinted, heat-absorbing, plate glass. All panels were custom built and prefabricated, the majority being 5 ft 5 in. wide by 4 ft 11 in. high. The aggregate weight per square foot of wall surface including sash, insulated spandrel, glass, and grid steel is approximately 5 lb. Each panel is supported on a continuous $4 \times 4 \times {}^1/_4$ shelf angle attached to the spandrel beam, and is secured to the shelf angle and to the concrete floor slabs. The metal-glass façading was erected at the rate of two floors per week with a crew of 24 to 30 men.

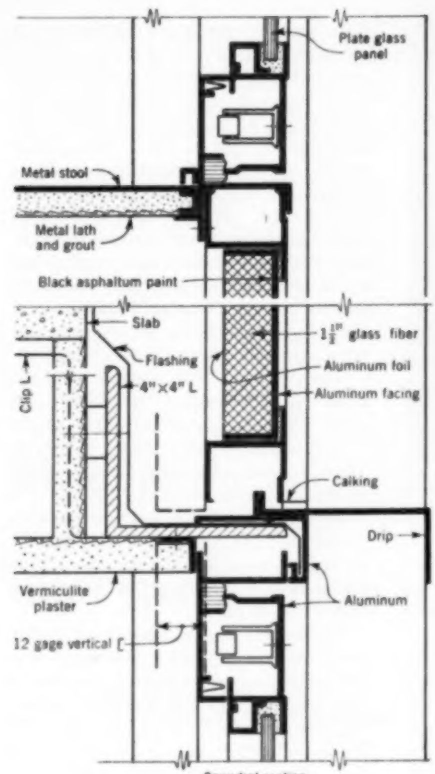
In addition, the architect specified the facing of one bay for the full height of the building on the street corner, and one face of the penthouse tower, to be a thin, precast facing slab of reinforced architectural concrete, a material identified as Mosai, and having an exposed aggregate surface which is mosaic in character. Slabs were approximately 5 ft $\times$ 6 ft $\times$ 2 in. in thickness, weighing 25 psf, and were secured by bolting to a steel-angle grillage attached to the structural frame.

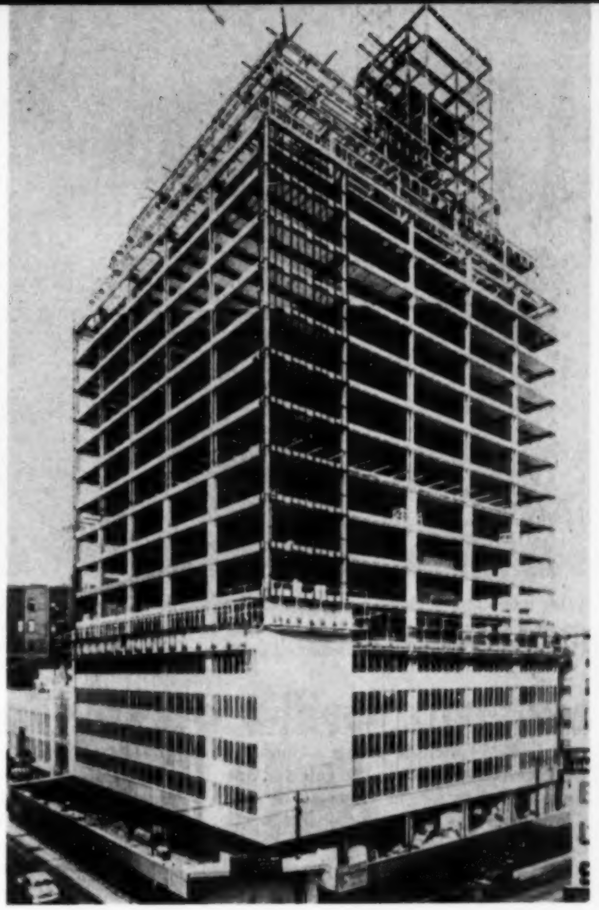
The preliminary analysis of the structural steel frame was begun simultaneously with the owner's decision to proceed with the construction of this project. At that time, the controlled materials situation made it desirable to negotiate a separate contract to insure procurement of the structural steel before execution of the general contract, so that a date could be set for occupancy. This procedure proved justifiable, permitting the structural steel to be fabricated and erected in accordance with the overall predetermined schedule of the architect-engineer for completion.

In view of the critical time element, and the height-width ratio of the structure ($2^1/_4$ to 1), it was concluded that the portal method of wind-stress analysis would be satisfactory. In compliance with the City and County of Denver Building Code, the structure was designed for a wind pressure of 20 psf. All bents were designed as wind bents, and shallow wind bracing was employed throughout.

The exterior columns are set back 1 ft 4 in. from the building lines. All exterior bays are 23 ft 8 in.; all interior bays are 25 ft 0 in. center to center of columns. All columns up to the 17th floor are 14 WF sections; however, in some instances it was necessary to add plates to the column sections when unforeseeable changes occurred in the upper floor loadings, since the structural sections had been mill ordered on the basis of the preliminary design calculations. In general, each bay contains two filler beams, usually a 14 WF 34, spaced 8 ft 4 in. on centers. Girder sizes vary from the minimum of 18 WF 60 up to 21 WF 73. Except for minor connections in isolated instances the entire structural frame was riveted.

Considerable economy was effected by the use of lightweight, fireproof plaster. Except for the four elevator bay columns, which were encased for their full height in lightweight concrete, most of the columns were fireproofed with lightweight Vermiculite plaster. Similarly, the floor framing steel was not





Above:

Steel grillage for support of precast concrete facing slab is seen in foreground above 6th floor level. Scaffolds for erection of metal-glass facading and precast spandrel slabs for lower floors were suspended from 10th floor framing as here shown. Scaffolds were later moved to 17th floor.

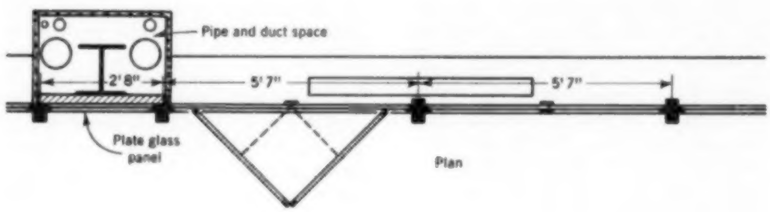
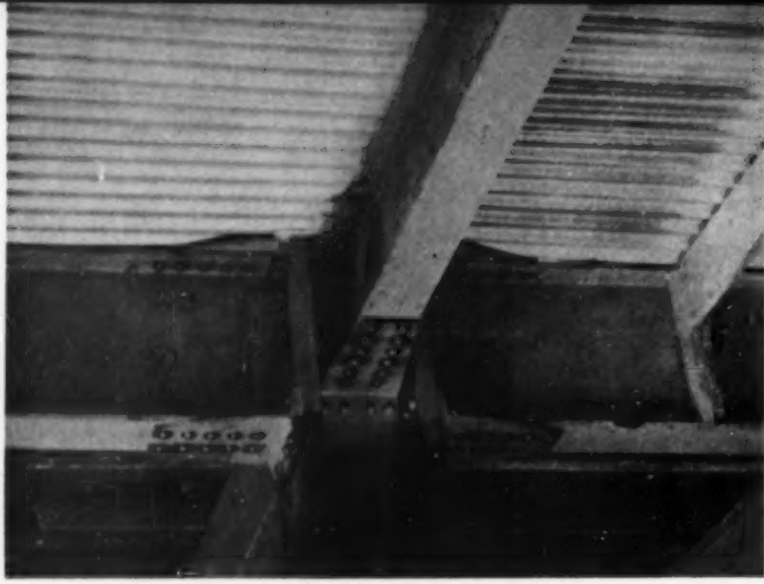


FIG. 2. Details of metal-glass facading on street lines are given in plan, above, and spandrel section below. Facading consists of aluminum insulated sandwich panel in spandrel area and Browne folding-flue aluminum window panel.

Right:

Foundation problem was solved by drilling bell-bottomed pier to support each of the 36 structural columns. Here, drill rig in center, with boom at an angle, has just completed drilling pier hole. Winch on jeep removes broken shale from a pier bell.



Wind moment connections were riveted to girders. Generally split 24 I's 105.9 were used up to and including 13th floor framing, and angles top and bottom above this level. Conventional Vermiculite suspended ceiling was later placed.

encased but protected by a suspended ceiling of Vermiculite plaster. Spandrel beams were encased on the exterior side only with lightweight concrete as part of the floor-slab concreting operations.

The total quantity of structural steel in the entire structure is approximately 2,650 tons. The gross floor area (office space and club portion) is approximately 313,000 sq ft, of which 88 percent is usable rental area. The total cubic content of the structure is approximately 3,840,000 cu ft.

Corrugated steel for floors

During the preliminary design phase, our attention was attracted to a relatively new floor system which is enjoying increasing utility in the building construction industry and which has proved to be well suited for multi-story steel-frame construction. This construction consists of corrugated steel units of high tensile strength bearing the trade name of Cofar. These units support and become an integral part of the lightweight concrete floor slab in which the under-floor duct system is embedded.

The Cofar units function as the positive and temperature reinforcement and also as the form for the reinforced concrete slab construction. Transverse wires, called T-wires, welded across the corrugations, furnish the necessary temperature reinforcing and transfer horizontal shear from concrete to steel form. Cofar units, $2^1/_2$ ft wide, were shop cut to fit the structural framing, in this case 8-ft 4-in. spacing, and field cut at columns and other openings. Units were welded to the steel frame by Nelson studs approximately 12 in. on centers. Before placing of the Cofar units, one intermediate line of temporary timber shores was installed and supported by wedges on the bottom flanges of the filler beams. Placing and welding of the Cofar units to the structural frame followed close behind steel erection and provided both a working deck and safety protection for workers below. The handling weight of each Cofar unit was approximately 40 lb.

The structural slab consists generally of a $4^1/_2$-in. thickness of lightweight concrete, which weighs about 106 lb per cu ft and has an average slump of $2^1/_2$ in. when placed. The lightweight aggregate is an expanded shale, produced in nearby Golden, Colo., with 100 percent passing a $^3/_4$-in. screen. Concrete is designed for an ultimate strength of 2,000 psi at 28 days. Design live load for the floors was 50 psf.

Embedded in the slab is an underfloor duct system with feeder ducts on 6-ft centers in one direction consisting of one duct for 115-volt electrical service and one duct for telephone service. By means of preset inserts in the duct as 2-ft intervals, convenient outlets for each service can be readily supplied, thereby providing flexible and economical distribution systems to meet any changing needs of the rental areas of the building.

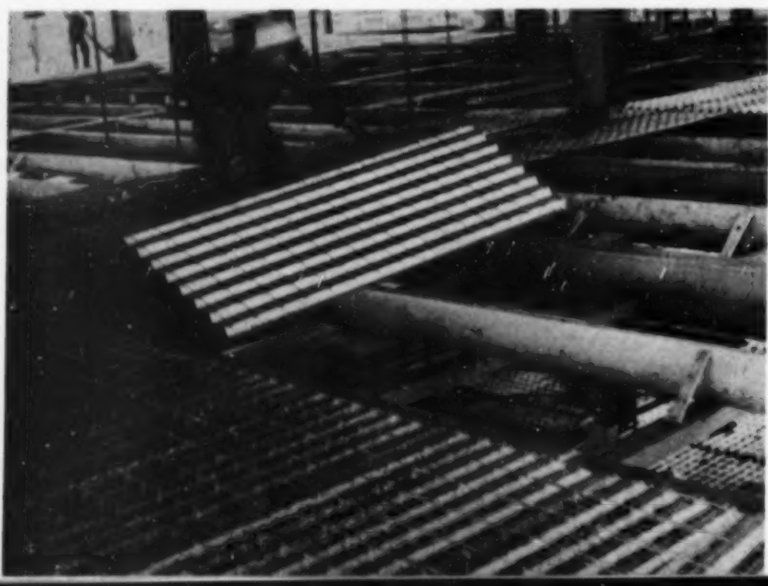
In keeping with the increased use of air conditioning throughout the United States, the Denver Club Building will become the first office building in Denver to be fully air conditioned. Six high-speed elevators will serve the office part of the building and will be supplemented by several others to serve the club and penthouse. Transformer vaults will be located in the basement and at the 21st floor level.

The architect-engineer combination commissioned by the owner to perform the design, supervision, and administration of the entire construction project is Raymond Harry Ervin and Robert Berne, architects, of Denver, and the Technic Engineering Company, structural engineers of Dallas. Mechanical and electrical engineers are respectively Marshall & Johnson and the Weers Electrical Planning Service, both of Denver.

The Mead & Mount Construction Co., of Denver, is the general contractor. Burkhardt Steel Co., of Denver, fabricated and erected the structural steel.

Acknowledgment is made to George McCormick, Chief Building Inspector of the City of Denver, for his cooperative assistance to the architect-engineer throughout the design and construction of the project.

Floor system consists of corrugated steel "Cofar" units of high tensile strength which support, act as forms for, and become integral part of, lightweight concrete floor slab. Sheets are welded to structural frame. Note simplicity of bracing.



S. E. RIDGE, M. ASCE

Chief, Maintenance Control Section
Maintenance Branch, Engineering Division
Bureau of Public Roads, Washington, D. C.

Barriers, marking and protecting repair areas, must be large and placed well ahead of work areas on modern superhighways. Unimpeded flow of high-speed traffic lulls drivers into a sense of security they did not feel on old-type roads.

Maintenance of high-speed, high-traffic highways a difficult problem

But costs can be reduced on design board, in equipment factory, and by competitive contracting

Highway transportation is now undergoing a transition as great as that through which it passed in the early part of the century. New limited-access highways, designed to carry large volumes of traffic for long distances at relatively high speeds, are being planned and constructed throughout the country. With these advances have come new and costly maintenance problems. There is need for close teamwork between designers, equipment manufacturers, and contractors to keep this public expense down.

Present trends in traffic volume and speed indicate that many more miles of such roads will be required in the immediate future. Last year, the people of the nation traveled over half a trillion vehicle-miles. By 1965, three-quarters of a trillion vehicle-miles of travel are anticipated.

In 1946 the average speed of all vehicles was 45 miles per hour; by 1953, the average speed had risen to 49.7 miles per hour. These trends will create the need for additional miles of high-speed, high-traffic highways, and the highway user will demand such construction.

We must not forget, however, that the construction of such highways is only part of the problem. If the maximum service for which the highways have been designed and constructed is to be obtained, they must also be properly maintained and operated. Many special problems are involved in the maintenance and operation of the new high-type highways, and these problems are worthy of careful consideration.

The average highway of today is a two-lane road with a surface from 18 to 20 ft wide. On many sections carrying heavy traffic, high speed is not possible because of congestion, intersections at grade, restricted sight distances, steep grades and alignment. On the other hand, the sections on which high speeds can be attained safely do not ordinarily carry heavy traffic. The standard to which these highways are maintained is much higher than in the early days, and many more services are provided by maintenance departments for the safety and comfort of motorists. With a few exceptions, roads are maintained and operated for year-round travel. Directional and informational signing must be erected. Surface failures must be repaired in a matter of hours rather than days. Like other large industries of the country, most highway departments are well organized and equipped to do the required work economically. But even so, the 1953 maintenance bill amounted to $1.7 billion for the country as a whole.

Tomorrow's highways, a relatively few of which are in operation today, are an entirely different type of facility. Whatever you call them—turnpikes, parkways, thruways, freeways, or limited-access highways—they have one thing in common: they all provide for the movement of relatively high volumes of traffic at relatively high speeds, for relatively long distances. On them, the driver comes to expect that an obstruction-free surface will always be ahead of him. He loses the expectation that the unexpected will happen. He is, to some degree, lulled into a false sense of security. This is not, in any sense, a criticism of the design of these highways. In fact, the designers of the new Garden State Parkway have attempted to counteract it by providing toll booths at intervals along the facility. The designers of other facilities have used other methods. It is, however, a fact that must be taken into account by the maintenance authorities when they send men out to work on or near the traveled way of these high-speed, high-traffic routes.

Highways of this type also differ in their geometric and structural characteristics. There is, for example, more surface to be maintained. Not only are there more lanes but each lane is wider. Shoulders are wider and frequently there are four instead of two. The right-of-way is wider so that roadside maintenance is increased substan-

tially. Median strips usually separate the opposing lanes of traffic and these must be maintained.

Cross traffic is eliminated by grade-separation structures with the result that many more overpasses and underpasses must be maintained. Drainage structures are longer, and sometimes rather elaborate systems are required to carry off surface water.

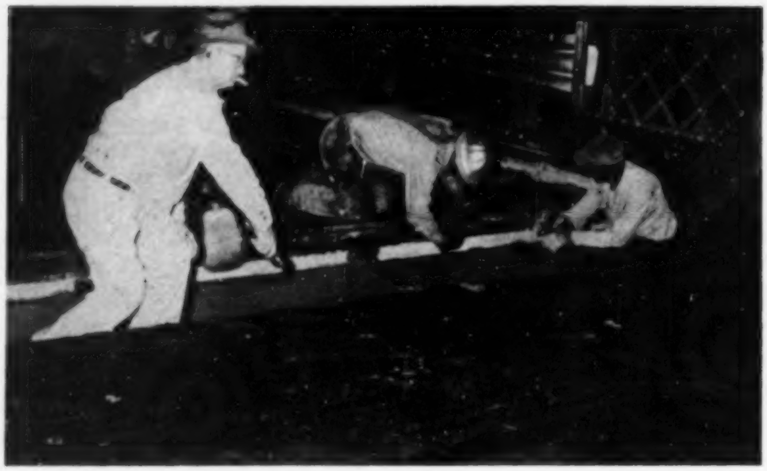
Another outstanding difference is in the traffic service devices to be maintained. More signs are required and they usually must be oversize to adjust to the higher traffic speed. Frequently, a secondary system of trail-blazer signs must be maintained to guide motorists to the facility. Special signs to warn motorists of hazardous conditions must also be maintained. Lane and other pavement markings are necessities, and because of the large number of lanes, the amount of marking is large.

For the protection of highway users traveling at high speeds, delineators are often installed along the shoulders or in the median strip. The mortality rate of these devices is high and they must be replaced and repaired continually. Guard rail is also used to a greater extent. This adds to the maintenance workload. In general, therefore, these high-speed, high-traffic highways require a far greater amount of maintenance effort than the ordinary road of today.

In addition, the maintenance of these new high-speed routes is a dangerous operation. It is dangerous both to the men working on or adjacent to the traveled way and to drivers operating vehicles on the highway. Drivers who have been maintaining relatively high speeds for prolonged periods come to expect that the road ahead will be free of obstructions. It is necessary, therefore, to warn them well in advance that some part of the roadway surface is obstructed, and this warning must be of such size and design that it will be certain to catch their attention.

It will also be necessary for many maintenance operations, such as resurfacing and other work requiring closure of the traveled way, to be performed when the traffic flow is low. Unfortunately, these low-traffic periods normally occur in the early morning, and work at these hours will be costly. It will be necessary to pay the men higher wages, and the materials, such as bituminous plant mix or transit-mix concrete, will cost more. Lighting of the work site will also be necessary.

And finally, the maintenance of these new facilities will need to be more exact. Surface irregularities that are not noticeable at slow speeds become a traffic hazard at 60 miles per hour.



Working hours for this bridge-deck repair job are 11 p.m. to 5 a.m. Necessity of working during hours of low traffic volume keeps such maintenance costs up.

The surface tolerance must therefore be lower on this type of road.

It is evident therefore that the maintenance and operation cost of these new high-speed, high-traffic facilities will be high. Whereas we now think of maintenance costs in terms of one thousand or so dollars per mile per year, we must soon start to think in terms of ten thousand dollars per mile per year. Although this seems a relatively high figure in terms of dollars per mile, it is not particularly high when considered in terms of dollars per vehicle-mile of service provided. With last years's maintenance outlay of $1.7 billion, maintenance and operation services were provided for 540 billion vehicle-miles of highway transportation—less than one-third of a cent for each vehicle-mile of travel, or an annual expenditure of slightly over $1 for each daily vehicle-mile. Today's high-type rural highways may carry an average traffic of 30,000 vehicles per day. For such a traffic volume, $10,000 per mile amounts to only one-tenth of a cent per vehicle-mile, or an annual expenditure of 33 cents per daily vehicle-mile.

Design can reduce maintenance costs

Engineers will be interested in ways of keeping these maintenance costs down and there are many ways in which this can be done. The design and construction of the highway has a major effect on maintenance costs. Steep, sharp cut and fill slopes are difficult to mow and are subject to erosion, especially during the first few years, thus adding to maintenance costs. They also make it necessary to install additional guard rail, and the maintenance of this guard rail and of the area around it becomes a burden on the maintenance forces.

The shoulders of these superhighways will be subjected to a very damaging type of wear. The wear caused by the high-speed traffic decelerating and attempting to regain the highway is as damaging to the shoulder as ordinary traffic wear is to the roadway. Shoulder-surface designs should be made with this fact in mind.

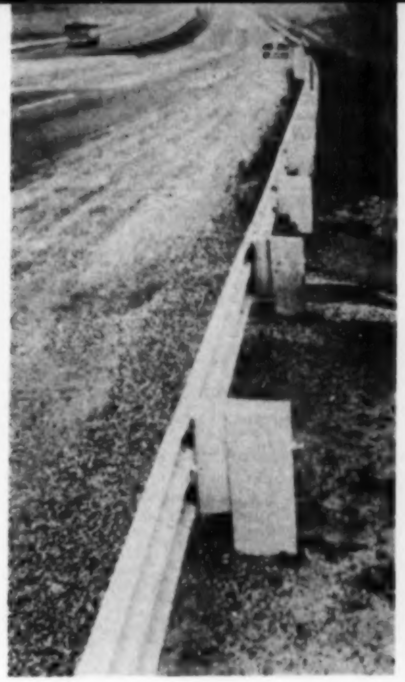
Planting along such highways should be so grouped that it does not interfere with the mechanized mowing of the roadsides. Any obstruction of the right-of-way or median strip will increase mowing costs.

Equipment manufacturers can help

The equipment manufacturing industry, which has already made a vast contribution to the improvement of maintenance methods, can assist still further in reducing maintenance cost on these high-type, high-speed facilities. There are several fields in which such improvements can be made. For example, the equipment manufacturer can make it possible to secure the reduced surface tolerances required by high-speed traffic. Present development work on the heater-planer is a step in this direction. Mowing equipment now on the market is certainly far superior to the original mowing machines developed for agricultural use, but it is still necessary to use some hand labor. Full mechanization should be achieved. Also, the equipment now being used for cleaning ditches and

↑ **Mowing along parkways is major item of maintenance bill. Designers, by simplifying center malls and rights-of-way, can make possible maximum use of machinery and thereby cut maintenance costs.**

Painting of many miles of guard rail along today's superhighways is an item that readily lends itself to maintenance by contract. →



drainage channels could be improved. One machine and one man should do the work now being performed by two machines and three or four men.

Materials manufacturers can also make their contribution to the reduction of maintenance costs. Paint, both traffic and structural, is particularly important in the maintenance of high-traffic, limited-access facilities. Faster drying of traffic paints would reduce the obstruction to traffic during the application of traffic markings. Longer paint life would reduce the frequency of this operation—now needed three or four times a year on high-traffic arteries. The wide roadside areas are a fertile field for the use of growth-retardent and weed-killing chemicals. The large amount of guard rail and the large number of sign supports make the use of sterilization chemicals imperative. Improvements in surfacing materials would of course be most beneficial.

Maintenance by contract

The third field, and probably the one in which there is the greatest possibility of immediate benefits, is the field of maintenance by contract. Although highway maintenance is thought of as an operation that is performed by governmental forces—state, city, county, or local—a substantial amount is performed by the contract method.

One of the latest and probably the most complete reports on the part the contractor plays in highway maintenance was presented at last winter's meeting of the American Association of State Highway Officials. This report, prepared by the Subcommittee on Contract Maintenance of the Maintenance and Equipment Committee, showed that out of the $600 million expended for maintenance of state highways, $60 million, or 10 percent, was expended for the contract performance of maintenance items, and that another $40 million, or 7 percent, was expended for the contract performance of minor improvements performed under the supervision of the maintenance organization. Thus at least one-sixth of all work performed by the state maintenance departments was performed by contract. It is of interest to note that, of the 35 states reporting their experience with the performance of maintenance by contract, 25, or 70 percent, reported a favorable reaction.

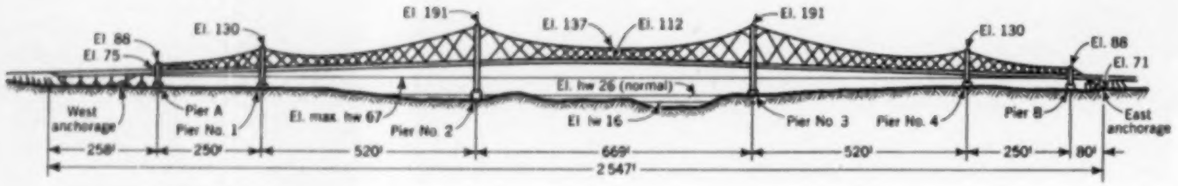
State maintenance authorities are ordinarily more than willing to let their work by contract if certain conditions can be met. First of all, it must be possible to establish a unit of work on which payment can be made. Secondly, there must be contractors available who are experienced in the type of work to be performed and who have experienced men and suitable equipment for such work. It is also desirable that the number of contractors interested in performing the work be sufficient to provide a healthy amount of competition.

On the relatively new type of highway here being discussed, there is a definite field for the expansion of contract maintenance. The large amount of steel structures and the miles of steel guard rail can be painted by contract. The surface repairs which, under heavy traffic volumes can be expected to consist of such items as resurfacing, crack sealing, mudjacking, and undersealing, are all susceptible to contract performance.

There is one factor, however, that must be considered by the contractor before he enters into a contract for the performance of maintenance on these high-traffic, high-speed roads, and that is the precautions he will have to take for the safety of his workmen and the traveling public. On construction work, there is not too much danger from traffic. Traffic, if it is allowed over the project at all, is usually traveling at reduced speed and the drivers know they are operating on a road that is legally closed. On maintenance work, however, the situation is reversed. Traffic has every right to expect that it will be able to move over the road with as little delay as possible. The attitude on maintenance work must be that the traveling public has the right-of-way and should suffer as little inconvenience as possible. To perform work under these conditions will cost more. If the cost of such protection is not included in the bid, the contractor will lose money or, even more serious, he will not take the necessary precautions and accidents will occur. Should accidents become frequent, the contractor will soon see his work opportunities disappearing, for no highway authority can afford to allow its accident rate to increase.

(This article has been prepared from the paper presented by Mr. Ridge at the ASCE Atlantic City Convention, before the Highway Division session presided over by Roy E. Jorgensen, M. ASCE.)

FIG. 1. San Marcos Bridge in remote part of El Salvador is a cable-stiffened suspension structure. Although not of unusual length, design embodies unique features.



A prophetic design in an out-of-the-way place

Located on one of the expanding systems of highways in Latin America, but remote from the main streams of world traffic, the San Marcos Bridge is not spectacular in the length of its spans. It is not even a part of the Pan American Highway. And yet, for all who have been connected with it in some capacity, either in design or construction, this structure is a thoroughly absorbing subject, with countless facets of general and professional interest.

This bridge is in the small but progressive country of El Salvador, located on the Pacific Coast of Central America where that coast runs almost east and west. El Salvador, about twice the size of New Jersey, is at Latitude 13 (Philadelphia is at Latitude 40), and nestles in between Guatemala, which forms its western boundary, and Honduras which bounds it on the north and east. The bridge is on the Pacific alluvial plain about 12 miles from the ocean. It spans a stream known as the Lempa River, which has as its watershed the greater part of the country's area, as well as parts of Guatemala and Honduras. The upper reaches of the watershed are very mountainous and thus the river is subject to heavy flash floods in the rainy season—May to October inclusive.

By means of this bridge, highway transportation will be made available to a fertile section of farm land hemmed in by the river, the ocean, and a range of mountains. This section had previously been able to reach its market only by rail. It will also be a link in El Salvador's proposed coastal highway. Fifty miles from the capital city of San Salvador, the bridge is not near any center of population. It is, however, close to the bridge carrying the railroad which connects the seaport with the capital.

The official name of the bridge is El Puento del Litoral, which means "the Coastal Bridge." To us who helped create it, however, it will always be the San Marcos Bridge, named for the little village on the east bank of the river at that point.

The bridge was designed, manufactured and constructed, including foundations, by the John A. Roebling's Sons Corp. under a contract with the government of El Salvador. Following a practice widely used everywhere but in the United States, bids were taken for design and construction—the specifications being very general in nature. Bids were received in March of 1948. The Roebling bid was low by about 20 percent in competition with conventional types of suspension bridges, cantilevers, and arches. The structural steel was furnished by the Belmont Iron Works of Philadelphia.

This two-lane highway bridge is designed for H15-S12-44 traffic. The total suspended length is approximately 2,200 ft, divided into five spans, of which the longest is 670 ft. The little ribbon along the roadway is a 36-in rolled section. If this depth of stiffening member is projected by direct proportion up to the span of the original ill-fated Tacoma-Narrows Bridge, this 36-in. beam will be found to be deeper in proportion. But even the use of the design theory of the Tacoma Bridge would have resulted in a tremendously heavier stiffening girder or truss, because this is a multiple-span bridge, and because the live load is heavier in proportion on account of the shortness of the spans. Thus, the 36-in. steel beam of the San Marcos Bridge is of value only to span between panel points and to provide local stiffness.

Actually, the design should be classified as a suspension bridge with respect to dead load only. Under the action of live load it is a continuous truss, made up entirely of tension members. It is a strange experience to place one's finger on the center of the middle span of a model of this bridge and see the tops of the end towers move apart.

Following the failure of the Tacoma Narrows Bridge, all engineers interested in the field began searching for the most economical means of avoiding such an occurrence in the future. To avoid another such failure was no problem, but to find the most economical solution required original thinking and imagination. The thinking of the Roebling

BLAIR BIRDSALL, M. ASCE, Chief Engineer, Bridge Division, John A. Roebling's Sons Corporation, Trenton, N. J.

Company in this direction was guided by the late C. C. Sunderland, our former chief, to whose creative vision this structure is a fitting monument.

By a strange coincidence our thinking turned to wire as a possible means of providing stiffness. The investigation involved experimental structures which were sometimes purely academic, and in other cases also functional. First came studies on paper, then preliminary laboratory models, then a small office footbridge, followed by a multiple-span footbridge built across the Delaware River. Next came a highway bridge study for the Corps of Engineers involving structural models. A prototype structure was under contract as a part of the same program at the end of hostilities in 1945. Then came a design investigation for a long pipeline bridge across the Mississippi—and finally the San Marcos Bridge, the latest and by far the most significant application to date of the idea of the cable stiffened bridge.

All materials were shipped by water through the Panama Canal, where they had to be transshipped to the Pacific port of Cutuco in El Salvador. From there they were moved by rail to the bridge site. Obviously, there was no machine shop or hardware store around the corner, and the job had to be absolutely self-sufficient.

The geological formations at the site are worth a word or two. On the east side, rock ledges are visible at the river's edge. These consist of a soft sedimentary rock, known as Talpetate, which underlies the surface soil at the location of all foundations on the east side, including the anchorage. On the west side there is no rock in evidence even 100 ft below the surface—nothing but layers of sand, clay, and gravel.

Construction of a bridge of this magnitude in such a remote location posed many challenging problems. The contract required that 90 percent of the labor be recruited in the country. This was nothing new to our erection supervisors; we have always done it as a matter of good public relations. Actually, there were as many as 500 men on the payroll at one time, but there were never more than four gringos at the job site. This labor program does require a lot of on-the-job training. Wages are low, but costs are comparable to those in the States—an indication that efficiency is more or less proportionate to wages.

Even though the site was initially cleared of practically all growth but grass, it was necessary to employ a full-time gang of grass-cutters to keep the tropical growth under control. This characteristic of the climate is strikingly illustrated when one sees a row of wooden fence posts sprout and become trees.

For the Government of El Salvador the contract for the bridge was administered by the Ministry of Public Works and most of the work was done during the tenure of the present Minister, Engineer Atilio Garcia Prieto, and his Sub-Secretary, Engineer Baltasar Perla. The late Engineer Julio Mejia was Resident Engineer at the site.

For the contractor, the drafting-room work on design was carried out under the direct supervision of H. K. Preston, Jr., A.M. ASCE. Work in the field was handled by a team of Salvadorean and North American engineers made up of those who have participated in this symposium, Engineer Wilfredo Mejia of El Salvador, who executed the original layout and triangulation, plus later control surveys, and Engineer Hector Butter, M. ASCE, of El Salvador, who acted as Assistant Superintendent during part of the work. W. A. Reeve, M. ASCE, was Contract Manager and General Coordinator of Field Operations.

The details of the design and construction of this bridge will be discussed in the articles that follow.

(Mr. Birdsall's article, and also the four following articles by Messrs. Sollenberger, Prugh, Hills, and Nixon, have been prepared from the papers by these authors presented in the Construction Division's symposium on "The Cable-Stiffened Suspension Bridge," at the ASCE Atlantic City Convention. This symposium session was presided over by Arthur E. Poole, Chairman of the Division's Executive Committee, and Warren Riker, chairman of its Committee on Programs at Technical Sessions.)

San Marcos Bridge is multiple-span suspension bridge stiffened by a truss composed of cables. Overall view shows main cable saddles on end tower as well as upper cable bands and lower-chord connectors. All towers are mounted on rockers.

NORMAN J. SOLLENBERGER

F. van Buren & Company, San Salvador

El Salvador, C. A.

SAN MARCOS BRIDGE...

"Cable-truss" design greatly increases stiffness

Three important differences between the conventional suspension bridge and the San Marcos Bridge are apparent. The suspenders are inclined at an angle of from 30 to 45 deg from the vertical, the suspension points are not equally spaced, and the size of the stiffening girder is relatively small. However, the actual stiffening is provided by the system of cables and not by the 36 WF beams. The weight of the beams varies because the suspender points are not equally spaced.

The structure is symmetrical except for the back stays and approach spans. It consists of five spans supported by two main cables over six rocker-based towers. The suspended roadway is composed of a reinforced concrete slab over a grillage of stringers and floor beams which frame into the 36 WF beams. These wide-flange beams lie directly beneath the main cables and are supported by them at suspension points.

Stiffening of suspension bridges by means of cables is not new. John A. Roebling used this basic approach when he installed diagonal stays on his bridges. Ideas of this type have been filed with the U.S. Patent Office as far back as 60 years ago. The late C. C. Sunderland, former Chief Engineer of the Bridge Division of the John A. Roebling's Sons Corp., was a proponent of cable stiffening for many years and applied it successfully for stabilizing footwalks used in erecting the cables on such structures as the George Washington and Golden Gate bridges.

Collapse of the first Tacoma Narrows Bridge revived interest in the possibility of using cables to assist in stiffening future structures of similar proportions. Since then cable stiffening has been used with varying success. Two examples of its successful use perhaps should be mentioned. D. B. Steinman, M. ASCE, used the principle to stabilize the Deer Isle Bridge, and Matthews & Kenan have used it to stabilize existing pipeline bridges and are employing it in present designs.

The design of the San Marcos Bridge is the result of considerable experience and development. The Roebling Corporation built an inter-office footbridge in 1943 which is still functioning effectively. During the war, it experimented with cable stiffening systems for the Corps of Engineers and built the one-tenth scale model shown in a photograph. Later the Corporation erected a 5-span footbridge across the Delaware River at Lumberville, Pa., which consisted of five cable-stiffened spans supported by rocker-based towers.

By this time two general types of cable configuration had evolved. One is the use of two main cables on each side of the bridge, placed one beneath the other, the lower cable being given a larger sag. This type is useful for light structures because vertical compression struts can be placed between the main cables, and large initial tensions can be placed in the diagonals. The second type involves one main cable on each side of the bridge and in general relies on diagonal suspenders which replace the vertical ones. This type is useful for heavy structures because the weight of the suspended roadway provides the initial tension in the diagonal suspenders.

The designation "cable truss" as used in connection with the San Marcos Bridge means what it says. A truss consists of an upper chord, a lower chord, and diagonals between them to transfer shearing forces. Members of a

truss must be able to resist either tension or compression and must be so designed that overloads do not cause harmful buckling of the compression members. The stiffness of a truss is proportional to the product of Young's modulus for the material and the moment of inertia. The moment of inertia of a truss is proportional to the product of the area of the chord members and the square of the distance between them.

The cable of a suspension bridge, which is supporting the dead load of the structure, makes an excellent upper-chord member for the truss. A main cable with an initial tension, say of one million pounds, may be subjected to compressive stresses up to one million pounds before buckling takes place. Buckling in this case means simply that the cable becomes slack, and no structural damage results. This principle is the reverse of that used in prestressed concrete design, where initial compression is applied to the concrete so that it can resist tensile stresses.

The diagonals, which support the dead and live loads of the roadway, are also subjected to initial tension and therefore can act as compression members. The lower chord of the truss may be the roadway itself or, as is the case with the San Marcos Bridge, cables tensioned by hydraulic jacks may be placed at the roadway level. In this case the lower chord is independent of the suspended roadway.

In a cable truss the spacing between suspension points must vary so that the diagonals can be placed at an efficient angle for transferring shear between the two chords.

It is difficult to evaluate the effectiveness of such a truss. The moment of inertia is quite large in the neighborhood of the quarter point of the span and at the towers, but is small or can be zero at the center of the span. Also it is possible that the shear deflections of the truss may be large because of the small total area of the diagonal suspenders.

In an attempt to evaluate the effective stiffness of the cable truss, two identical models were fabricated and observed at the Roebling plant in Trenton, N.J., as shown in an accompanying photograph. The details of one were such that a model o' a conventional bridge resulted when a bar was inserted to act as a stiffening truss. The details of the other were such that a model of a cable truss resulted. Deflections and frequencies of oscillation were observed on the two models under identical conditions.

The size of the bar in the model of the conventional bridge was increased by trial until both models appeared to perform the same. Then it was concluded that the cable truss was equal in effectiveness to the truss in the model of the conventional bridge. If this result is scaled to the size of existing bridges, the effectiveness of the cable truss appears impressive. The model predicts, for instance, that such a truss designed into the Golden Gate Bridge would produce an effective stiffness of over 80 times that provided. Since the models were small and inexpensively built, one hesitates to project the conclusions too far, but considerable confidence was gained as a result of these observations.

The San Marcos Bridge is a two-lane highway bridge designed for AASHO H15-S12-44 traffic loading. There is one 3-ft 4-in. sidewalk on each side of the roadway. The main cables, spaced 30 ft apart, are of open-type construction. Each main cable is composed of 24 galvanized bridge strands of $1\frac{1}{2}$-in. diameter. Two additional strands added to the backstay portion of each main cable hold the end towers upright. Each lower chord cable consists of eight galvanized bridge strands of $1^{3}/_{8}$-in. diameter. One length of the diagonal cables extends from the main cable to the lower-chord cable, where it passes over an inverted saddle, and back again to the main cable at another point. In general the diagonals consist of one galvanized bridge rope of $1^{3}/_{8}$-in. diameter, but where the loading requires it, there are two.

As is the case with any truss, every intersection of the diagonals with the upper or lower-chord cables requires positive load-transfer connections. At intersections of main cables and diagonals, a steel connector or cable band clamps the 24 main-cable strands in four groups of six (Fig. 1). The diagonals are fastened to the steel connector by a socket-and-pin arrangement. The connector at each lower-chord intersection point (Fig. 2) serves three functions: it provides an inverted saddle for the diagonals, a clamp for effecting a connection to the lower-chord cables, and a vertical link from which the 36 WF beams are suspended.

The center span is 669 ft long, the two intermediate spans 520 ft, and the two end spans 250 ft, making a total of 2,209 ft. The suspended roadway steel is one continuous unit from one end of the bridge to the other. It passes through the four intermediate towers without touching them except for wind tongues which prevent transverse motion. Longitudinal motion is controlled by anchoring the diagonals in the end spans directly to the 36 WF beams.

To predict deflections and to check cable tensions, a one-twentieth scale model was built, completely equipped with tension dynamometers consisting of SR-4 electrical gages glued to small steel tension links. It was possible to place a load on the model and weigh it within a few percent simply by computing the vertical components of the cable-tension dynamometer readings.

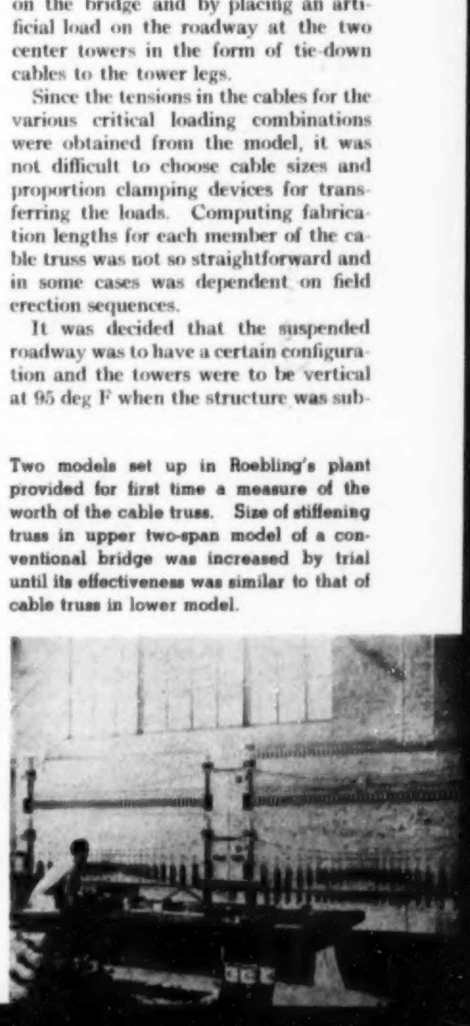
The performance of the model was observed when subjected to various extremes of live loadings. All appeared to function as desired except that certain diagonals became slack under certain load combinations. Although slack diagonals are not undesirable from a structural point of view, it was found that they could be eliminated by making the initial adjustment of the diagonal lengths with one-third of the live load on the bridge and by placing an artificial load on the roadway at the two center towers in the form of tie-down cables to the tower legs.

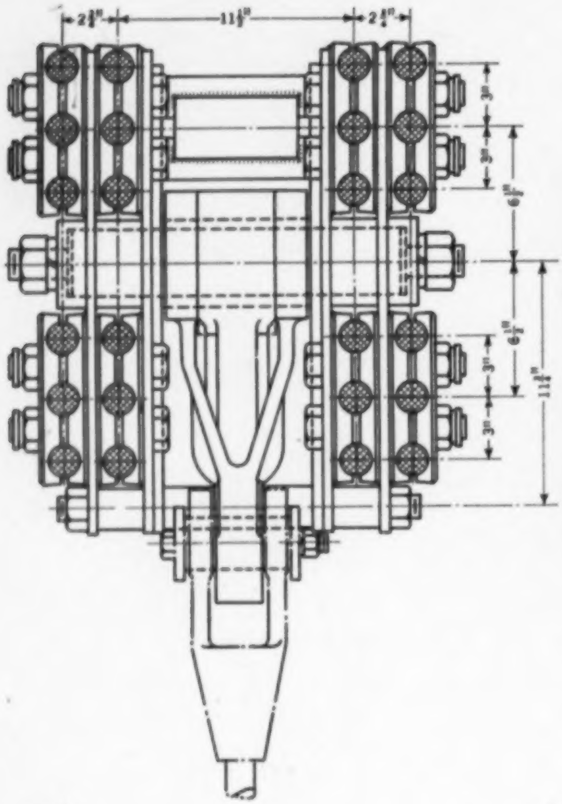
Since the tensions in the cables for the various critical loading combinations were obtained from the model, it was not difficult to choose cable sizes and proportion clamping devices for transferring the loads. Computing fabrication lengths for each member of the cable truss was not so straightforward and in some cases was dependent on field erection sequences.

It was decided that the suspended roadway was to have a certain configuration and the towers were to be vertical at 95 deg F when the structure was sub-

In study of stiffening systems for Corps of Engineers, one-tenth scale model of 600-ft single-span bridge was built and observed at Roebling's plant in Trenton, N. J.

Two models set up in Roebling's plant provided for first time a measure of the worth of the cable truss. Size of stiffening truss in upper two-span model of a conventional bridge was increased by trial until its effectiveness was similar to that of cable truss in lower model.





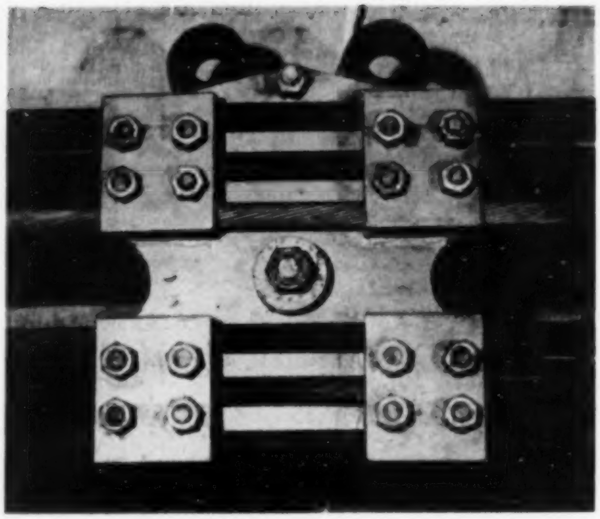


FIG. 1. Twenty-four strands of main cable are clamped into steel connector or cable band at each intersection with diagonals. Figure shows cross section of cable band and photo shows side view. Cables are divided into four quadrants each consisting of two vertical rows of three strands. Both vertical and horizontal spacing of strands inside quadrants is about 3 in., and spacing between quadrants is about twice this distance.

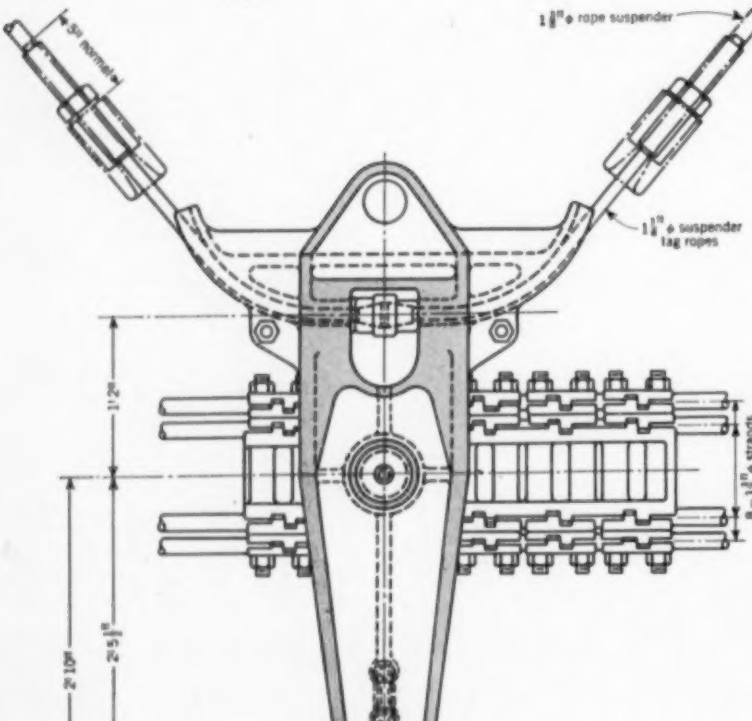


FIG. 2. Lower-chord cable connector assembly ties diagonal suspenders to main 36 WF girder running along each side of deck. Each bolt in girder is drawn up to full tension of 20,000 psi during assembly.

jected to dead load plus one-third live load over the entire bridge. All final adjustment of the diagonals was done under these conditions. Then, after the lower-chord cables were clamped in place and the one-third live load was removed, the bridge would remain somewhat above the elevation of the original configuration and would deflect below it only when the one-third live loading was exceeded.

The 36 WF beams, into which the floor system frames, were assumed to be one long, continuous girder supported only at suspension points. Since the suspension points were not equally spaced, the vertical force at each location was computed by moment distribution. These forces were then delivered to the cable truss by hanger links.

Determination of the distribution of the vertical loads into the cable truss at suspension points could have been a statically indeterminate problem had it not been for the field erection procedure. The clamps to the lower-chord cables were not tightened until the bridge was completely adjusted. Complete adjust-

ment meant that the suspended roadway conformed to the desired configuration and that the tension links at the suspension points were vertical. This procedure allowed the vertical force at the suspension points to be proportioned into the diagonal cables by using statics only, and thus the loadings on the main cable were available.

The main cable bands do not lie on a parabolic curve and the horizontal component of the main-cable tension is not constant as is the case in the conventional suspension bridge.

As the horizontal location of the suspension points and the main-cable bands were fixed at the beginning, only the vertical locations of the main-cable bands remained to be determined. Since the slope of the diagonals depended on the vertical location of the main-cable bands, and since the loading in the diagonals was a function of their slopes, a trial-and-error procedure was used to locate the main-cable bands. First they were assumed to lie on a parabolic curve, and the approximate diagonal slopes were determined. From this information the location of the main-cable bands was computed and corrected slopes were obtained. These calculations converged very rapidly because the third trial was considered sufficiently accurate for practical purposes. Cable lengths were then calculated.

Every member of the cable truss was prestretched, fabricated to exact length, and marked for its special destination at the Roebling's New Jersey plant. But as cables and strands tend to change length slightly as a result of handling, provision was made in every case for a small amount of field adjustment.

A very interesting feature in the design of the San Marcos Bridge is the anchorage for the lower-chord cables. As mentioned previously, these were the only cables that required artificial tensioning. Since the lower-chord cables did not become a part of the structure until after the final adjustment of the cables, these cables did not need to be tensioned until after the full dead load plus one-third live load was in place. Therefore the lower-chord cables were anchored into the reinforced concrete roadway.

Precautions were taken to prevent bond between the concrete roadway and the structural steel beneath it so that the concrete could shorten under the compression stresses imposed by the lower-chord cables without causing undesirable stresses in the structural steel. In this way a convenient anchorage was available. In addition, the roadway concrete is expected to give a better performance as a result of the continual compression to which it is subjected.

A multiple-span suspension bridge usually is subject to considerable tower-top motion unless the towers are built rigid enough to resist it, or tie cables between tower tops are installed, or heavy stiffening trusses much heavier than those normally required are used. In the San Marcos Bridge the cable truss is sufficiently rigid to require no assistance from any of these sources. Therefore all towers are mounted on rocker bases and the 36-in. wide-flange beam is used only to transfer roadway loads to suspension points.

The depth of the cable truss at the center of the main span is 25 ft. This depth was maintained to provide an effective truss throughout the span. This distance between the roadway and cables at mid-span requires the same extra height in the towers, but since the towers are mounted on rockers the extra height does not represent a large increase in cost.

It is fortunate that a limited number of load-deflection tests on the full-size structure are available. For this purpose the Government of El Salvador collected 64 trucks, each loaded to a gross weight of 16.6 tons. Three different loading distributions were used. The vertical movement at the centerlines of the three spans and the horizontal movement of the tops of the two center towers were observed.

For the first test, 0.60 of the full live load (580 lb per ft of bridge) was placed over the entire structure. The center span deflected downward 8.2 in., and the two intermediate spans deflected downward 6.6 and 7.4 in.

The second test involved loading only the two intermediate spans with 104 percent of full live loading (1,000 lb per ft of bridge). The center span deflected upward 23 in. and the two intermediate spans deflected downward 24.6 and 23.8 in. The tops of the two central towers deflected toward the anchorages 5.3 and 4.5 in.

The third test involved loading the center span with 91 percent of full live load and the two intermediate spans with 43 percent. The central span deflected downward 34.8 in. and the intermediate spans deflected downward 17.2 and 15.6 in. The tops of the two central towers deflected toward each other 5.7 and 6.0 in.

No model test results are available which exactly duplicate the field tests, but interpolation of model test results indicates fair agreement with field observations. According to predictions, the horizontal motion of the tops of the two main towers will not exceed 8 in., and maximum deflection in the main span will not exceed 49 in. under the most adverse conditions.

The ability of the structure to resist disturbing forces of aerodynamic origin was given prime consideration throughout the design. The stability of a suspension bridge depends upon the weight of the suspended structure, the effectiveness of the stiffening elements, the damping capacity of the structure, and avoidance of undue aerodynamic disturbances.

A concrete roadway was used for several reasons, one of which was the weight it economically provides. A relatively small cable sag of 8 percent of the span length was used. This feature adds overall stability to the structure.

The stiffness of the structure for the most part depends upon the cable truss. Its very satisfactory exhibition of stiffness and damping properties is the key which makes the design possible. Of course it is essential to reduce the aerodynamic disturbing forces as much as possible. The cables themselves are aerodynamically quite stable, and the floor section is provided with a 12-in. space or vent between the 36.-in. wide-flange beams and the concrete sidewalks.

A suspended span designed as a cable truss oscillates as a single unit, that is, in single-segment motion. The stiffness of the cable truss at the quarter points of the span is such that two-segment motion is difficult to produce. If the San Marcos Bridge were to oscillate, each span would move as a unit and would require the other spans to move in harmony. With this in mind the span lengths were chosen such that this harmonious movement cannot occur.

At this time speculation over the performance of the structure is unnecessary. The San Marcos Bridge has been in service for approximately two years. Sixteen-ton trucks passing over the structure cause no deflection evident to the unaided eye and, most important of all, the bridge does not oscillate nor has it exhibited a tendency to do so.

It is true that this bridge must be considered small in comparison with the important suspension bridges of today. The fact that the cable truss has served well in providing economical stiffening for this structure does not guarantee that similar results will be obtained on long-span bridges. However, experience up to the present time indicates that a large amount of stiffening is available, and it appears that the design is almost certain to be economical for multiple-span projects. As for the typical long-span suspension bridge consisting of a main span and two side spans, the cable truss provides so much stiffness and damping capacity that reasonable aerodynamic forces would almost certainly be controlled. This leads to the conclusion that the benefits of the cable truss should be investigated when any major structure is planned.

Anchorage excavation tests versatility of wellpoints

BYRON J. PRUGH, A.M. ASCE, Assistant Chief Engineer, Moretrench Corporation, New York, N. Y.

Complicating combinations of soil strata tested the ingenuity of the wellpoint engineers during the construction to the west anchorage for the San Marcos Bridge. Not only were the wellpoint systems required to dewater the excavation, but they also had to relieve the upward pressure of an underlying sand aquifer and stabilize the clay strata in the lower part of the excavation. Close tolerances imposed by the balance of the suspension system complicated the problem.

Geologically the bridge site was very interesting, being located approximately equidistant from two semi-active volcanoes, San Vincente and San Miguel. The area is constantly subjected to earth tremors of varying intensity, necessitating maximum stability of the soils to avoid slides caused by vibration. Dr. Julio E. Mejia, prominent engineer of El Salvador, reports that seismographs in San Salvador record an average of one earth shock of some magnitude per day. Several of our daily engineering reports bore the terse notation, "slight eatrhquake today." A major disturbance, with the epicenter less than 25 miles to the east, occurred during construction in May 1951, destroying several entire towns but not damaging the bridge project.

The problem of volcanic soils first manifested itself during the construction of the west pier of the bridge, when layers and pockets of a fine gravel or grit composed of light porous volcanic material were encountered. This material had an approximate dry density of 46 to 58 lb per cu ft and a specific gravity of about 1.71. Because of the extreme lightness of this soil, several panels of the steel sheeting blew in. Wellpoints were used successfully to reduce the uplift pressure and no further trouble was encountered in repairing the sheeting and completing the pier according to specifications.

At the west cable anchorage, which is about 500 ft from the river, the ground-water level is about 20 ft from the surface during low water in the dry season. Floods in the area, combined with the relatively high permeability of the soils, caused considerable fluctuation in the ground-water level. One flood, while construction was in progress, raised the piezometric water level 17 ft to within 3 ft of the surface. Piezometers installed in and around the excavation, including a well 500 ft to the west, gave an accurate picture of the piezometric pressures in the various soil layers at all times.

The underlying soils may be divided into three main strata (Fig. 1): (1) upper stratum, 35 ft thick; (2) middle (clay) stratum, 24 ft thick; and (3) lower stratum, of fine sand, greater than 40 ft thick. The anchorage excavation was approximately 50 ft deep. The upper and lower stratum were each subdivided into two layers, giving a total of five different layers. All layers were sedimentary, alluvially deposited. An examination of native artifacts uncovered 20 to 30 ft below the surface showed that the upper layer may have been deposited as recently as 300 years ago.

There was no sharp line of delineation between any of the layers, but rather a transition zone of approximately 1 ft. Generally speaking, the sand of the two layers of the upper stratum was composed by volume of about 50 percent quartz, 40 percent light gray, porous, volcanic material, and 10 percent dark or black, hard, shiny, volcanic material. The specific gravity ranged from 1.8 to 2.6, with a dry density of from 70 to 90 lb per cu ft. Porous volcanic material predominated in the larger grain sizes down to about the 100-mesh screen. The lower stratum (No. 3) had less lightweight matter, with a specific gravity ranging from 2.0 to 2.6, and a dry density of 75 to 90 lb per cu ft.

The top 15-ft layer of the upper stratum was a brown coarse and medium sand, a little fine gravel and fine sand, with a trace of clay, essentially subangular in grain shape. It had a uniformity coefficient of 1.6 to 3.0, a typical S-type grain-size curve, and good permeability equal to that of uniform coarse sand. This layer blended into the second 20-ft layer, which was a brownish sandy clay, laminated with horizontal fine-sand lenses of varying thicknesses. Composition of the fine sand in the lenses was similar to the top layer with the exception that the grain-size curves were almost linear with a uniformity coefficient of about 3.0, very angular grain shapes, and low permeability due to high clay content. After being sun-dried, the whole layer would support almost vertical slopes. This was due to the high clay content in the fine-sand lenses.

The third layer or middle (clay) stratum (No. 2) was a light brown, stiff to hard clay, full of interlocking pipes ranging from capillary size to ½ in., evidently caused by the disintegration of organic material in the original deposit. Because of this tangled and interlocking pore-tube system, which readily conducted water, the stratum might be called ironically a "pervious clay."

The top 15 ft of the lower stratum (No. 3) was a loose, angular fine sand with a uniformity coefficient of from 1.7 to 2.6, and of a brownish salt-and-pepper color. The trace of silt did not seem to affect the normal permeability for fine sand.

This layer graduated into the lowest layer of loose, angular, coarse and medium sand, with a little fine gravel. The uniformity coefficient was from 2.0 to 3.2 Because of its high void ratio, angularity, and low relative density, the lowest layer proved to be an ideal aquifer and source of hydrostatic pressure.

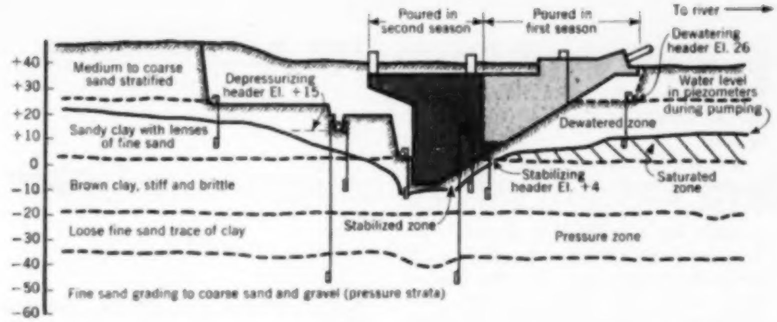


FIG. 1. Soil profile at west anchorage necessitated use of three wellpoint systems. The first dewatered the excavation, the second depressurized the lower sand stratum, and the third stabilized the middle or clay stratum.

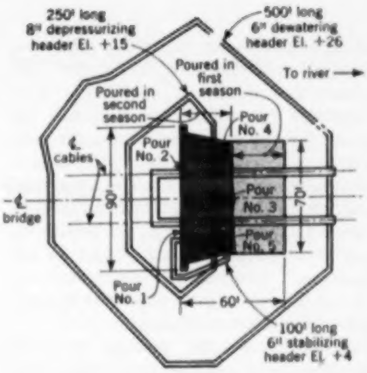


FIG. 2. Plan of anchorage indicates location of pours Nos. 1 through 5, made during second season. Each pour was made in individually excavated deep pocket, pours Nos. 1 and 2 being put in first. This procedure was necessary to preclude any movement of first year's pour down inclined face of anchorage. (See Fig. 1.)

The wellpoint installation was functionalized to meet the three different problems created by the major stratum. Initially 500 ft of header pipe with 100 wellpoints were placed to surround the entire general excavation at the existing ground-water elevation, 17 ft below the surface. Despite several flash floods, this system lowered the ground water the designed 16 ft in the top stratum and maintained it at this elevation during the first working dry season. This header ring circled a relatively large area, created by removal of overburden to reduce the pressure on the middle stratum, providing a large low-elevation working level. This upper dewatering system allowed the top half of the anchorage to be poured without trouble "in the dry."

During the tropical rainy season, work was suspended on the anchorage and was concentrated on the cables and suspended steel, which could be erected working from the completed part of the anchorage. By working on the anchorage only in the dry season, the amount of excavation and form work was materially reduced, as there was no danger of rains crumbling the steep, undisturbed soil slopes against which the concrete was placed.

Pressure relief header placed

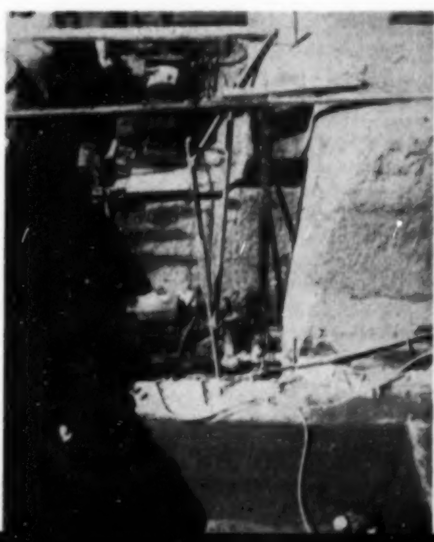
When the rains slackened and allowed resumption of work on the anchorage, a second 8-in. header pipe was placed in a hand-dug trench, 9 ft below the first working area. Fifty-one depressurizing (pressure relief) wellpoints 60 ft long were installed with the screen sections placed in the coarse-sand aquifer some 85 ft below the original ground surface. Maximum pressure relief was ensured by sealing the top few feet of the hole around each depressurizing wellpoint with an impervious material. The purpose of these wellpoints was to reduce the uplift pressure against the bottom of the clay layer to such a degree that open excavation could be made with no detrimental changes in the properties of the clay. This was of prime importance as the anchorage was designed without piles, depending on the bearing values of the soil alone.

Any movement of the anchorage, either during construction or after

Below left:
Deep pour No. 1, made during second season, was excavated in the open to El. −8.0. Header at El. + 4.0 was for wellpoint system stabilizing middle (clay) stratum. Note nearly vertical side slopes of excavation.

Below center:
Laborers prepare wellpoint for self-jetting and sanding. All the well-points were self-jetted.

Below right:
Hand-built masonry flume discharged all flows from wellpoint systems into river. Flume made possible accurate measurement of all discharges and facilitated placement of pumps and piping.



completion, would materially affect the bridge superstructure. Therefore the speed and depth of excavation were carefully controlled by observing the ground-water elevations and uplift pressures as measured by piezometers. Readings were compared against precalculated tables which allowed an adequate factor of safety against both shear and moment in the clay caused by unbalanced hydrostatic pressures. Internal pressures in the clay were reduced by stabilization wellpoints.

Because of the average pressure differential of over 60 ft of water, and the large permeability of the aquifer, a 10-ft rise in the piezometric head was built up in two minutes if the pumps were stopped. Since a 10-ft recovery took 6 hours, it was found expedient to have spare pumps on a stand-by basis while all critical excavation was going on.

Clay stratum stabilized

To meet the third problem, 25 stabilization wellpoints were installed in the middle (clay) layer on the second-stage header to reduce the moisture content and pore pressures. Each wellpoint was installed with a sand column around it and an impervious seal at the top for performance under the "vacuum" method, that is, as well as the pervious clay would permit. It was necessary to hand-screen and mix local sand to obtain the correct gradation for a filter of maximum effectiveness.

The second stage allowed general excavation to be carried out in safety to within 12 ft of the bottom of the anchorage. From this level five separate pockets, each approximately 15 by 30 ft in area, were excavated and poured individually (Fig. 2). Deep pocket pours Nos. 1 and 2 were directly in line with the cable anchors in the upper portion of the anchorage poured the previous spring. These first two pours acted as a safety factor, preventing any movement of the previously poured top part down the inclined inner face of the anchorage.

The soil in each of these pockets was dewatered and stabilized by means of a ring of 6-in. header pipe and 30 wellpoints pumped by a jet-well pump. The limited working area made it necessary to reinstall this third system around each pocket. Although only about 75 gpm were pumped in each pocket, the soil became stabilized to such an extent that the vertical sides of the excavation were used as forms except on pours Nos. 1 and 2. Spare wellpoint pumps were again essential, as alternate wetting and drying of the clay slopes caused vertical shear planes to develop in the clay. Such shearing was triggered by either an earth tremor or machinery vibration. Even though the pockets actually were excavated under the bottom of the top anchorage pour, the anchorage was completed without trouble.

All wellpoints were self-jetted and sanded by hand labor, except the 60-ft wellpoints which were lifted into jetting position by a stifflegged derrick. Individual discharge pipes ran from each wellpoint pump to the top of the excavation, where all discharges were collected in a hand-built masonry flume which ran around the three riverward sides of the excavation and eventually discharged the water some 300 ft downstream. The flume allowed accurate measurement of the discharge waters and reduced the amount of work necessary for relocation of pumps and discharge piping caused by construction procedures.

It should be noted that during the first dry season of work, the boring holes and initial piezometer holes which extended into the pressure layer gave considerable trouble from boiling. This occurred whenever the excavation was carried below the normal ground-water level and did not stop until the pressure-relief wellpoints were in operation. The boils were temporarily controlled by a standpipe increasing the head, or by automatic mops and sump pumps. It is suggested that, whenever preliminary borings indicate the presence of a pressure area, these boring holes or any additional holes be thoroughly plugged with a clay, bentonite, or cement slurry. This is especially important when the holes pass through a stiff soil layer that might stay open and readily transmit heavy water flows from the pressure layer to the construction area.

This wellpoint installation, incorporating the functions of dewatering, soil stabilization, and pressure relief, proved advantageous for the following reasons: (1) it decreased the amount of excavation; (2) it virtually eliminated sheeting and shoring; (3) it permitted hand excavation for the last foot and placing of concrete against undisturbed soil; (4) dry working conditions in the excavation were provided; (5) movement of the cohesionless soils was prevented; and (6) by reducing the uplift pressure, it avoided the use of tremie concrete, which would otherwise have been necessary to avoid any fracture of the clay soil.

During the construction of the anchorage, the primary consideration was to take adequate precautions against any movement of the anchorage, then or in the future. It is felt that the use and economy of wellpoints on this project were a major factor in enabling the contractor to meet this requirement.

Cable

Cable erection for the San Marcos Bridge was originally scheduled to take place during the dry season, when the Lempa River is a quiet, placid stream 250 to 300 ft wide at the site. Little difficulty was expected and very little equipment was supplied from the States. What actually happened was that delays at the No. 1, or west, anchorage set back the schedule so that erection of the cables began after the start of the wet season and had to be continued through the worst part of the tropical rainy period.

Each cable consists of 24 galvanized bridge strands of $1^1/_2$-in. diameter [which are arranged as shown in Fig. 1, page 44]. Each strand is continuous over all six towers, is 2,500 ft long, and weighs about six tons as shipped on a wooden reel. The strands were completely prefabricated at the factory, where they were pretensioned to remove all non-elastic stretch and then measured and marked at dead-load tensions. The end sockets were affixed and zinc buttons cast on the strands a couple of feet each side of the center of the tower marks. Shims between these buttons and the saddles provided both a means of accurate adjustment and assurance against sliding until the dead load hanging on the cables became sufficient to hold the strands in place.

The cables terminate in a compact assembly of plates and bearing blocks. Shims between these bearing blocks and the sockets permitted individual adjustment of each strand to the nearest $^1/_{16}$ in.

At the towers, each strand rests in its own individual saddle groove. Saddles are so designed that the upper strands do not rest on the ones underneath, or cause any vertical pressure to be transmitted to them. The cables are actually divided into four quadrants, each consisting of two vertical rows of three strands. Both vertical and horizontal spacing of strands inside the quadrant is about 3 in., but the quadrants themselves are about twice this distance apart. This arrangement was dictated by the design of the cable bands but it proved a tremendous help in identifying strands during adjustment readings. With no footbridge or other means of access to the center of the

H. W. HILLS, Staff Engineer, John A. Roebling's Sons Corporation, Trenton, N. J.

erection complicated by floods and tropical climate

spans, all such readings had to be made from the towers by transit and binoculars.

Rain every day

It rained practically every day, although almost all of the rainfall occurred between 6:00 p.m. and 4:00 a.m. Thus, as we prepared to pull our first strands across, we were faced by a rising river, which already had isolated the western main tower except by boat. Before we finished, the river had reached a width of 1,200 ft. It had become a muddy flood passing the site at 12 mph, which might rise or fall several feet overnight. Its waters were practically saturated with floating tropical vegetation, ranging from water reeds and other plants to full-size trees weighing several tons.

An overhead or aerial system of cable erection (in which the strand is pulled from tower to tower without touching the ground or the river) was not possible because of lack of equipment and the condition of the wooden strand reels. These reels had become badly damaged from rot, termites, and iguano nests inside the barrels during the many months they were stored at the site.

We were thus forced to continue with the original plan adopted for dry-season erection, that is, to pull the strands across on the ground (protected by wood from abrasion), connecting them at both anchors, and then hoisting them to position at the towers. Power winches were rigged at each of the six towers. New gin poles replaced the rotted poles which had erected the towers. Lines were run from the hoists to these poles and down to lifting beams at the base of each tower. Outhaul falls were rigged at each tower to hold the lifting beam and cable strand clear of the tower columns during raising operations. Hand winches and queues of native laborers on Manila falls manned these outhauls.

The hauling line was wire rope of $^5/_8$-in. diameter. It ran from the drum of one 100-hp hoist near the west anchor, over to the east anchor on a line 30 ft upstream from the center line of the bridge, and back to the west anchor on a line 30 ft downstream from the bridge. The line then ended on the drum of a second 100-hp hoist at the west anchor.

This line was in reality made in three pieces, each as long as the bridge from anchor to anchor. The two connections between the pieces consisted of chains of three shackles. The center shackle served as the attachment point of the tag to the lead socket of the main cable strands.

Unreeling stands built

Four unreeling stands were built, straddling the hauling line, just in front of the anchorages. We had distributed the 48 reels evenly to the two anchorages so that we could unreel alternately from each end. The condition of the reels was so bad that it took as long to mount one as it did to unreel the strand. Our erection goal was four strands, or one layer of one cable, per day. At about the halfway point in strand erection, we reached this goal and maintained it thereafter.

Snatch blocks hanging in falls on each side of the main towers held the hauling line clear of the water overnight and when not in use. We had no fear of the sidewise drag of the current on the bare hauling rope or cable strand, but we learned very quickly that we could not leave a line immersed in the vegetation-choked stream more than a few minutes. When delays occurred while lines were in the water, they became so fouled with clinging fronds and reeds that we could not lift them clear or pull them out, and could barely hold them from breaking away downstream. When such fouling occurred, a boatload of daring workers, armed with machete knives, had to work their precarious way out along the swinging, surging lines to hack the heavy mass free.

The sockets were placed in both anchors by hand, with long lines of natives literally carrying the heavy strands and sockets to position in the anchor assemblies.

The raising operation was always beautiful to watch as the strands were picked together at the six towers. As they broke loose from the river bottom, they frequently bounced wildly in the air from anchor to anchor, always being held in clear suspension by outhauls and uphauls. The actual raising usually took less than ten minutes. At times, the entire operation of unreeling and raising was done in an hour. But, in spite of this, we usually found ourselves racing against gathering darkness on the final strand of each day's operation. More than once the No. 2 tower crew came to shore in their small boats in nearly pitch-black darkness.

Because of lack of equipment at site, cables were hauled across river with power winches by means of hauling line at ground level. Gin poles and hoisting winches at each tower then lifted cables into position one by one. When debris carried by flood waters fouled hauling lines and cables, they had to be freed by boatloads of natives armed with machetes.

Critical location, tower No.2

Tower No. 2, isolated in the main stream, was the critical location throughout. After trying to operate from shore, the outhauls were finally rigged to winches on the top of the tower. Outhaul sheaves were anchored 150 ft above and below the pier, using whole batteries of sunken concrete-filled barrels. These lines and anchor tags frequently had to be cleared of floating trees and smaller debris. The attachment of uphauls to the main cable strands was especially difficult and hazardous at this tower—at times involving underwater work by naked workers held on safety lines to keep them from being swept away in the swift current.

Of course the accuracy and beauty of the final bridge profile depends on the accuracy of adjustment of the first free-hanging cable elements. Contrary to what might be expected, it is usually more difficult to correctly foretell the stretch of a cable—from this unloaded condition to dead load—on bridges of short span than on those of greater length.

At San Marcos the tension carried by the unloaded strands at free cable was insufficient to remove the effect of possible wire displacement which might have occurred during reeling and other operations after prestressing. Further, this free cable tension was below the straight-line portion of the stress-strain curve. Even the most careful laboratory tests could not foretell with complete accuracy how much the cables would actually stretch.

The possibility of error from any other source than cable stretch was eliminated. The spans were measured and remeasured. When I went down to El Salvador, I supervised a final re-check—using piano wire calibrated at night at the site. The line was held in free suspension under exact tension over a base line on shore. This base line had been repeatedly taped by standardized methods. The main span was checked to within 3 mm, or 1 in 65,000. Overall accuracy was nearly as high.

At the factory, prestressing and measuring operations had undergone the same careful procedure and check. We were confident that any consistent variation in free cable sags from tabular figures on our charts could only be caused by errors in assumption of the amount of actual stretch to dead load. The field force was provided with corrections to apply in this event.

Actually there was nothing really new, except for the number of spans involved, in our methods of adjustment, although it is possible that this was the first time such methods had been applied in tropical America. The bottom row of wires was adjusted by transits set at definite elevations at the towers, sighting on lighted targets across each span. Towers were preset at the proper lean so as to cause no horizontal unbalance of the free-hanging cable at the tower tops. Towers could be readily set at a given lean because of their pivot-type base design and erection stay bolts. Transits were used for verticality readings with lighted targets. Tower leans were determined simultaneously with sag readings. Actual readings were compared with theoretical sags as listed on charts giving the correct sags for all reasonable variations of span and temperature.

Readings had to be taken in early dawn

All adjustment readings were taken in the early dawn, that single hour before sun-up during which strands could be distinguished in the growing light of day. Even at the middle of the rainy season, the sun seldom failed to come out in full tropical strength on schedule at daybreak. Within a few minutes after sunrise, the towers and cables would be too badly affected by the heat for further readings.

The upper rows were also adjusted by transit and binoculars, using the sag targets at the far tower for perspective, which allowed us to judge the space between vertical layers at mid spans. The strands were seldom still. We felt compelled, in the interests of accuracy and even loading of strands, to take two sets of morning readings on consecutive days, with the crew adjusting the strands to position each morning before proceeding with the erection of new strands. This schedule of course fitted in perfectly and in fact dictated the intended goal of four strands per day, or one horizontal layer of one cable.

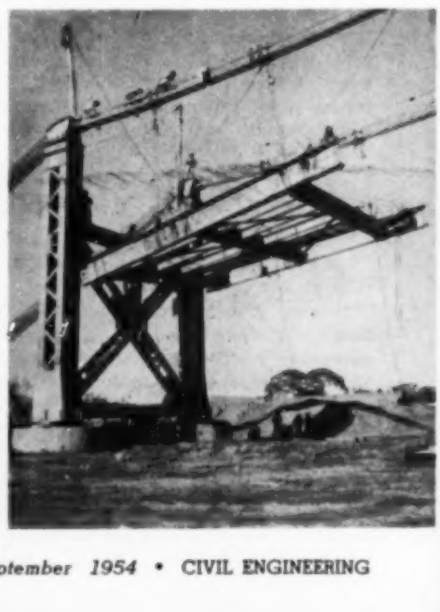
Cable sockets were placed in both anchorages by hand. Long lines of natives literally carried heavy strands and sockets to position in anchor assemblies.

Construction

A construction man may find his ideas of feasibility somewhat out of line when faced with the abundance of low-cost labor available in El Salvador. Thus it was easy to assemble a bucket brigade to supply mixing water when the pump broke down, or to use laborers to hold a large tarpaulin over the concrete pouring area during short tropical storms. Many engineers with wide experience in steel erection would have been amazed to see laborers moving slowly along the main cables pushing the assembled cable bands into place with their feet.

To assemble the cable bands, scaffolds were erected under each side of each main cable, at the top of the four center towers. The cable band forms the connection between the main cable and the diagonal suspenders supporting the roadway. [See Fig. 1 in Mr. Sollenberger's article, page 44.] Vertical plates, compressed against the strands by bolts, grip the cable. These bolts were not tightened during assembly since the bands were to be moved to their proper location along the cables, always in a downward direction, by a workman seated on the cable, pushing the band ahead of him with his feet. The proper

Preassembled 30-ft section of roadway is lifted into position by temporary hoists attached to main cables. Over water, each structural element was barged into place.



JOHN E. NIXON, John A. Roebling's Sons Corporation, Trenton, N. J.

methods adapted to local labor

location for each band was determined by painted marks on two strands of each main cable. These marks were placed on the strands while they were under measuring tension at the factory. The bolts were then tightened with a torque wrench. Since the main cables were wide and rigid, they made an excellent working platform and would be acceptable in our own country as a practical footbridge.

As dead load is applied to the bridge, the strands become smaller in diameter because of the increase in tension and seating of wires in the strands. Therefore cable-band bolts must be checked and tightened after each erection operation that adds an appreciable dead load to the bridge. Special care must be taken with band-bolt tightening on a cable-stiffened bridge since a horizontal load can be applied to the band by the diagonal suspenders.

Erection of suspenders

The diagonal suspenders are composed of $1^{3}/_{8}$-in. galvanized bridge rope with an open socket at one end and a bridge bowl at the other. The open socket connects with the cable band. Two tag ropes, side by side, resting in inverted saddles, form the roadway connection. These tag ropes are fastened to the bridge bowls of the diagonal suspenders.

Joining the diagonals to the roadway tag ropes would be a very difficult job if done after the suspenders were connected at the bands. Therefore this connection was made on the ground, and each end of the suspender assembly was hoisted to its proper cable band. The result was a dangerous and extremely slow rigging operation. Undoubtedly, here in the States, large trains of cable bands with properly located suspenders beneath them would have been assembled at the tower tops and the entire unit pulled into place as a train in a single operation.

Dampening clamps were placed on the main cable between cable bands. The reason for this is that tensioned ropes or strands suspended between two relatively stiff points (and cable bands are such points) will vibrate as a result of the movement of air across them. This is especially true when the air is moving at low velocities. If this action is not eliminated, the frequency and magnitude of the vibrations will be great enough to break the wires at the clamping points. When strands are joined to each other by a clamp that is not fixed by a suspender, the frequency variations of the strands will snub out any tendency for continuous motion.

Erecting the roadway steel

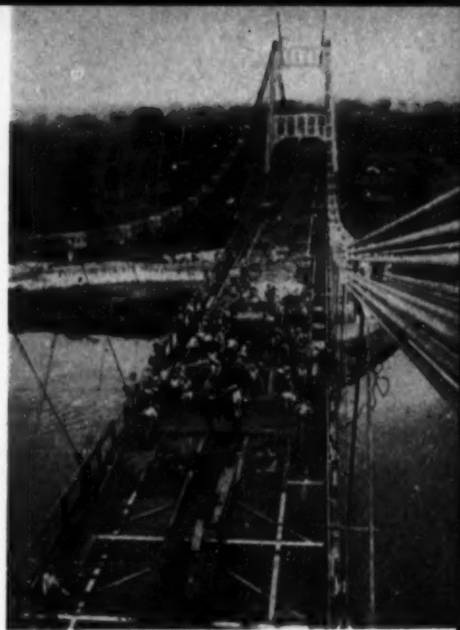
Roadway steel was assembled on the ground in sections composed of two 36 WF 150 girder beams, 30 ft long; two 30 WF 124 floor beams, 30 ft long, spaced at 15-ft intervals; and four 16 WF 26 stringer beams, spaced 6 ft apart (Fig. 1). Each unit weighed 10 tons. Where the suspended roadway passed over land, the sections were assembled under their proper location in the roadway. At other locations each steel element had to be barged to the correct location and hoisted from the barge. The main cable served as the hoist support.

First, sections were placed at the middle of each of the six spans, and the work then progressed in both directions from these erected units. Tower verticality readings were taken daily. The towers could not be damaged, however, since they are on rockers.

Erection and connection of steel on this job were relatively simple as compared with such operations on a conventional suspension bridge. The reasons are as follows:

1. Since the diagonals form the stiffening truss, there is not nearly as much steel to erect or connect, nor is a deep truss needed.
2. Less steel means less deflection due to weight, and therefore connections can be made as the steel is erected.
3. The diagonal system spreads the loads over the main cable, thus reducing local deflections.
4. Local deflection of the roadway is also reduced by the flat sag of the main cable.
5. The erection sequence of the steel floor sections is very flexible.

Riveting crews could drive 100 rivets per day. The low labor rate in many cases made it profitable to prolong the job where by this means fabrication costs in United States shops could be cut. The riveting operation is an example of this situation. No roadway steel was shop assembled. The small stature of the native presented a handicap as far as his ability to drive and buck rivets was concerned. An American crew could certainly drive more than 250 rivets a day on a bridge of this type, since the shallowness of the steel roadway sections reduces the scaffold moving time considerably.



Abundance of labor is evident from this view of concreting operations on deck. Concreting progressed in both directions simultaneously from center of each of the three long spans.

Pouring the concrete roadway

Concrete pouring started at the middle of each of the three long spans and continued in both directions. The result was six different working locations. Enough form wood was furnished to make a 30-ft length of roadway at each working location. This plan, which permitted the form material to be used several times, but placed severe restrictions on the pouring routine, was feasible because material costs were high and labor cheap. It is usually necessary to wait from seven to ten days before forms can be removed from the conventional floor. Therefore, high early-strength cement was used so that form removal could start 24 hours after the completion of a pour. The plywood sections were then lowered into a work car, moved forward, and installed in the next section. Curb and floor were poured as a single unit, requiring the steel curb forms to be moved along in the same manner as the plywood bottom sections. Next, the reinforcing rods were placed and tied. This proved to be one of the most difficult jobs for the untrained Salvadorians to master.

Concrete was produced by three 16-cu ft mixers, one in each of the long spans. All aggregates were manufactured at the bridge site and transported across the suspended steel on a

temporary plank roadway. Water was pumped to each mixer through the permanent handrail pipe. Peons with wheelbarrows transported the concrete from mixer to roadway pouring location.

Quick setting, due to the extreme heat and the insistence upon a maximum slump of 2 in. by the inspectors, caused considerable difficulty at first, and a retarding agent had to be added to the mix. After the masons had gained experience, the retarding agent was eliminated.

It was essential to spread water-soaked burlap over the concrete as soon as the masons were finished, in order to prevent hair-line cracks on the roadway surface. This was often only 15 minutes after the concrete was discharged from the mixer. The only excessive deflection caused by this continuous pouring of the roadway slab was in the two short end spans. These spans were loaded by dumping aggregate on them to prevent an undue rise of the roadway steel.

As the bridge stands today, the roadway is one continuous prestressed concrete slab, 2,200 ft in length. The prestressing force was produced by anchoring the eight $1^{3}/_{8}$-in. lower-chord strands into the roadway in the end spans (Fig. 2). Therefore, these strands could not be tensioned until the roadway slab was completed. These strands form the lower chord of the stiffening truss. To prevent the roadway from cracking, due to curing shrinkage, before the slab could be placed under compression, expansion joints were placed at mid span and at each tower.

The $1^{3}/_{8}$-in. lower-chord strands were unreeled from one end of the bridge. The lead socket was threaded through every lower suspender casting [Fig. 2 in Mr. Sollenberger's article, page 44] along the girder and anchored on the far side.

Then a 50-ton center-hole hydraulic ram was connected to the socket on the unreeling side. That socket was pulled into its anchor and secured. Hand pumps were employed to apply pressure. Gages on the pump were used as a check to see that each strand had a 70-kip tension in it.

A saddle for these strands is connected to the roadway suspender casting by a single center pin. Strands are clamped to this saddle with horizontal plates and vertical bolts. The upper two horizontal rows are clamped to the top of the saddle and the bottom two rows are clamped beneath.

A definite order in tensioning the horizontal rows of strands had to be followed to prevent one row of tensioned strands from placing a load on strands that were being tensioned. Friction created by this load would have caused different tensions to exist in the same strand. The first row to be tensioned was the second layer from the top, followed by the top layer, then the bottom layer, and finally the third from the top.

All roadway stringers were covered with two sheets of light-gage sheet iron, with an application of graphite grease between the sheets. This permitted the roadway slab to move independently of the floor stringers. The motion of the roadway slab is the result of:

1. Elastic shortening due to the load applied by the lower chord strands.
2. Shrinkage due to curing of the long slab.
3. Shrinkage due to the creep of the concrete under compression.

Asphalt surfacing

As with the concrete, the $^{1}/_{2}$-in. aggregate was manufactured at the site. First a coating of cut-back asphalt, RC-2, was brushed on the concrete. Then followed a coating of aggregate $^{3}/_{4}$ in. thick. Hot Trinidad asphalt was spread on this aggregate by men with containers very similar to watering cans. Finally, men with hand shovels spread sand over the surface.

Although nothing would be lost structurally by allowing the diagonal suspenders to become slack as the bridge was loaded, such a condition might possibly cause some concern to those on the bridge at the time. By experiment on the model it was determined that adjusting the suspenders with one-third the live load on the bridge would eliminate slack suspenders under any condition of partial loading or under full load. Sand was used for this one-third live load, and care had to be exercised since it was placed during the rainy season and could have been washed away. That was the reason for placing the sand down the center of the roadway. The camber of the roadway and the curb drains kept water away from the sand.

Suspenders were adjusted on the bridge bowls at the roadway suspender castings. Adjustment was accomplished by manpower, block and tackle, and open-end striking wrenches. This was a very brief operation which was undertaken chiefly as a check on the new design.

Adjusting checks were made to ensure the following:

1. Equal tensions in the double diagonal suspenders
2. Verticality of lower-chord suspender castings
3. Proper elevation of roadway
4. Bridge-bowl bearing face perpendicular to the suspender

All diagonals are clamped to each other wherever there is a cross, to prevent scrubbing. These clamps were all placed by men going up the suspenders hand over hand to the cross points. The necessary parts were then pulled up by Manila line. At the same time, all lower-chord casting clamps were tightened, to fasten them securely to the lower-chord strands.

With these adjustments finished, the bridge was completed and ready for use.

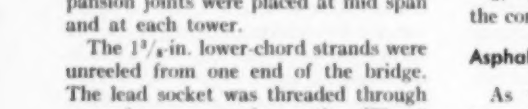


FIG. 1. Concrete deck of roadway was poured in 30-ft sections along with curb. Roadway is separated from stringers by graphite-greased sheets to permit independent movement.

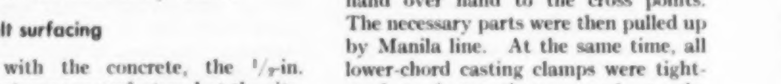


FIG. 2. Anchorages at each end of bridge are connected by tensioned lower-chord cables. Load of 70 kips in each cable prestresses 2,200-ft length of roadway slab.

Philadelphia's International Airport mirrors design progress

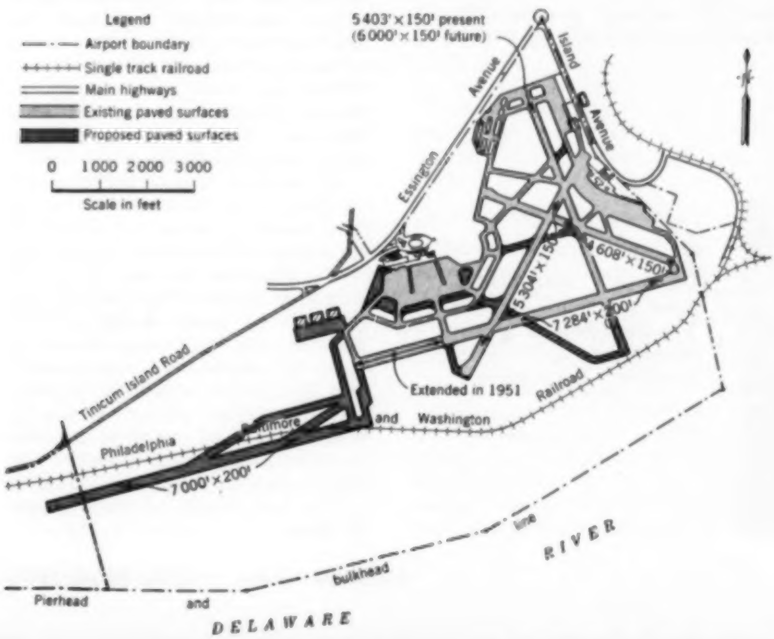
SAMUEL S. BAXTER, M. ASCE

Water Commissioner

City of Philadelphia, Pa.

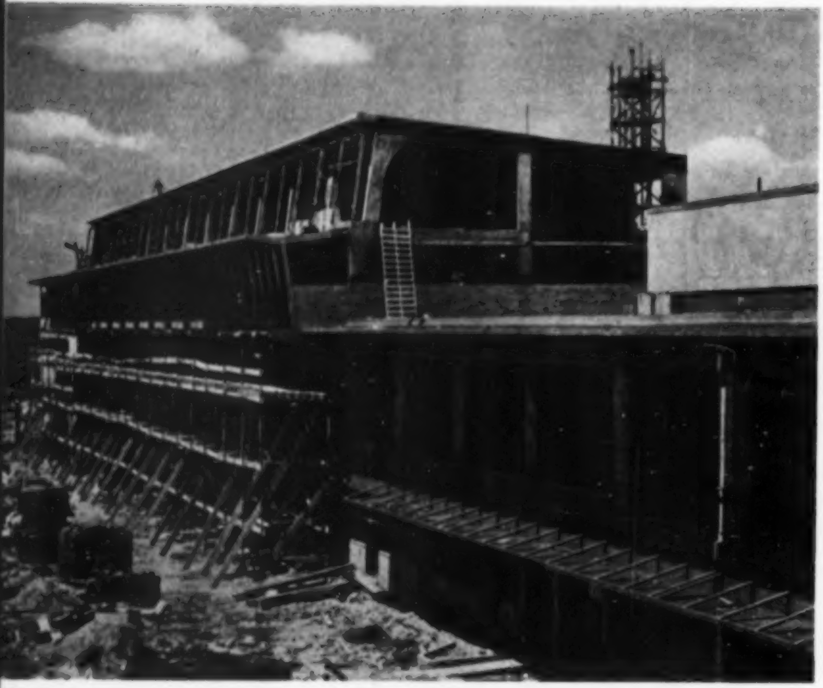
Near conclusion of World War II, Philadelphia undertook extensive reconstruction of its airport. First consideration was given to runway and taxiway layout, seen above in process of improvement.

FIG. 1. Master plan of Philadelphia International Airport shows existing and proposed structures and paved areas.



Behind the opening of the Philadelphia International Airport as a complete modern air terminal on December 12, 1953, lies a development of almost thirty years, extending through most of the history of modern commercial aviation.

Philadelphia's first venture into the municipal aviation field came in 1925 through a request from the Secretary of War that the city provide a site for the training of National Guard aviators. In that year, Philadelphia purchased 50.4 acres in the southwestern part of the city and added to it a tract of 124.4 acres, which was detached from a larger site originally purchased for sewage treatment purposes. The total tract of 175 acres cost $137,000 and was graded and improved at a cost of $93,000. Improvements in those days were in no way comparable with what are termed "airport improvements" today. In



Left:

New terminal building, which had to await completion of more urgent runway improvements, was started in July 1950, completed in December 1953. Site is stabilized swamp with piles under main buildings.

Right:

Improvements in late 1940's included four new rigid-frame hangars, each 150 × 125 ft.

Bituminous surfacing is placed in renovation program started in 1949 and still continuing. Need to seal and repair runways at moderate cost led to adoption of this method of placing from 1½ to 10-in. layer of bituminous material over old runway surfaces.

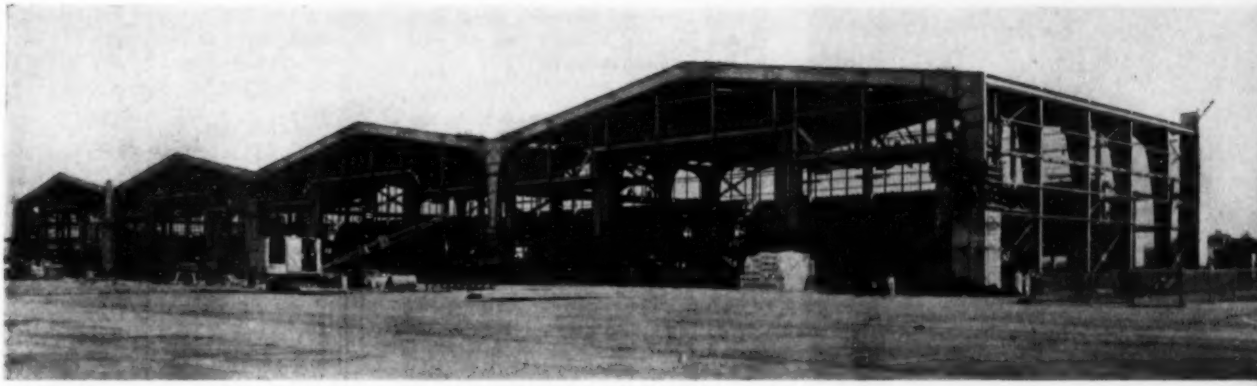
Triple 84-in. metal pipeline forms outfall line for main drainage system of airport. Approximately 2,000 ft of this construction was required.

1926, the field was leased to a private operator at a rental of $1.00 a year. Subsidies to pioneers in aviation were an accepted practice in those days.

Within two years the growing aviation industry began to feel the need for a larger site, and in 1930 the abandoned Hog Island Shipyard, used during World War I, was purchased from the Federal Government. This site, totaling 955.13 acres, was adjacent to the small field purchased in 1925. In selling the land, the Federal Government required that the City of Philadelphia make available 239 additional acres, in which was included the original 1926 site, making a total of 1,194 acres. Of this, 499 acres were reserved for the airfield proper. From 1930 on, there was a gradual development of this site.

Philadelphia International Airport is situated on the Delaware River immediately below the point where the Schuylkill River empties into it. The area was originally a low marsh. In colonial days and in the early 1800's, settlers and farmers reclaimed the marshy ground by building dikes known as "meadow banks," to protect the land against high tides and flood waters. Private companies were formed in some instances to build these meadow banks, which enclosed sites of varying sizes.

The existence of these banks and the condition of the soil below the meadows have played an important part in the engineering development of the airport. When the field was being filled during the middle 1930's, the principal emphasis was placed on having federal unemployment relief forces produce an operating airport. The designers of that day thought in terms of 25,000-lb DC-3's or similar planes. It was not realized that the airport would some day have to provide for planes of 100,000-lb weight on a regular basis, and be able to land 200,000- and even 300,000-lb planes.



Early fill of various types

As a result, various types of fill were placed. Some was excellent gravel dredged from the adjoining Delaware River and some was silty material also dredged from the river. Other areas were filled with ash and other materials hauled from nearby city dumps. It is on these materials that a large part of the present field and runways was built.

The meadow banks played an interesting part in the filling operations, although this was not recognized until additional construction was begun after World War II. Most of the meadow banks were impervious and held water, but in some cases, the banks were breached during airport construction which allowed water to pass through. As a result, water was found very near the surface in some locations and 3 ft or 4 ft lower at points only a few hundred feet distant. This variation in the water table presented a puzzling problem until the reason for it was discovered.

Early paving and drainage was done by city engineers experienced in sewer and paving construction in a large city. As a result, the basic storm drains were designed to carry off water faster than in modern airport design, and faster than installations on some much newer parts of the field.

An interesting innovation was the construction of concrete gutters along the paved edges of the runway with concrete covers having triangular-shaped openings which collect all water falling on the runway and carry it to the storm sewers and drains. No water reaches the unpaved infield areas or the adjacent shoulders, except what falls directly there. As a result, surface drainage problems have been almost non-existent despite the fact that all drainage from the field must be pumped into the Schuylkill River.

In the construction of the runways, the fill material was compacted in a manner similar to the preparation of a base for a city street. Bituminous macadam runways were built with specifications similar to highway paving. These runways consisted of $2^1/_2$ in. of asphaltic concrete on a 5-in. penetrated stone base. In the final design, three of the runways were paved 150 ft wide and the instrument runway, 200 ft wide. Runway lengths varied from 4,608 to 5,403 ft.

As the field part of the airport was completed, the need for terminal facilities became evident. In the late 1930's, Philadelphia, like many other cities, had very little money for public improvements. It therefore built what was expected to be a temporary terminal building. Work was begun in February 1939 and the building was opened in 1940.

Although this building was of temporary construction, financial shortages and the advent of World War II kept it in use until December 1953, when the new building was opened. The old building went through many changes and additions, literally springing forth on all sides. Its shortcomings were a source of annoyance to travelers and city officials, particularly after the end of World War II and the upswing in air travel.

Complete renovation planned

When it became evident that World War II was approaching a successful conclusion, the city began to center its attention on making the Philadelphia airport a modern metropolitan air terminal. In addition to the need for a new terminal building, many improvements were required in the field. First attention was given to a review of the runway and taxiway layout, with particular reference to the original four-runway pattern. CBR tests were made at several points on the runways, and full-scale load tests with a 30-in. plate were made at others. These showed a wide variation in strength. A report covering these tests recommended strengthening some sections of the runways and rebuilding others to make them usable by 300,000-lb planes.

These tests disclosed that:

1. The north half of the field was safe for planes with a gross load of 120,000 lb.
2. The south half of the field was safe for planes with a gross load of 90,000 lb.
3. For loads up to 200,000 lb, some parts of the runways were satisfactory with the addition of 3 in. of surfacing. In other places, at least 5 ft of the underlying material would have to be excavated and replaced with good material, and the runway rebuilt.
4. For loads up to 300,000 lb, additional work would be required.

The recommendations of this report, along with other factors, led to a review of the basic runway pattern. Studies were made by several units in the city government with the aid of outside engineers. One school of thought, influenced by the trend toward a three-runway pattern for commercial airports, called for the abandonment of the existing runways. Another group believed that the existing runways, after improvement, could satisfactorily serve the heavier plane loadings. The final decision was to retain the four-runway pattern.

Financial considerations played an important part in the postwar development of the field. Funds were insufficient to permit concurrent work on all desirable improvements. A basic policy decision made in 1947 gave priority to field improvements and new hangars over a new terminal building, and this decision dictated the general order in which work was performed.

Among the field improvements was the construction of four new hangars, each 150 ft wide and 125 ft deep, with

Control tower and glassed-in upper deck of new Terminal Building look out over loading area and runways.

adjacent lean-tos. It is of interest to note that the construction of these hangars focused attention on the paving design for the field. The concrete ramp paving in front of the old administration building had been built with very little preparation of the subsoil, and consisted of a concrete slab 7 in. thick with thickened edges. As heavier planes began to use this ramp in the late 1940's settlement and breaking occurred.

The ramp in front of the large new hangars was rationally designed for a 200,000-lb plane loading with the accepted design criteria in effect in 1948, when this ramp was started. It was of concrete construction 12 in. thick. Later a temporary cargo building was erected with extensive ramp facilities to provide for overflow parking of planes in inclement weather. Philadelphia gets large numbers of these planes during foggy weather, which closes down airports in New York, Washington, and other cities on the eastern seaboard. These ramp facilities were also designed for 200,000-lb planes, and were of concrete construction 10 in. thick.

It became evident, in line with the experience at many airports during the war, that new areas such as runway extensions, taxiways, and the ramp for the new terminal building, would require very different treatment from that used in the 1930's.

Terminal building site a swamp

The first area to be examined was the 156-acre site of the new terminal building and its adjacent ramps and peripheral taxiways. This area was a swamp about 12 ft below the proposed design grade. Many borings were made which showed a basal stratum of sand and gravel at an average depth of about 30 ft, above which were silt, clay and organic materials containing high percentages of water.

The method adopted was to haul and spread coarse sand and gravel available nearby from river dredgings and compact these materials in 1-ft layers. The specifications stated: "Each layer of fill shall be separately compacted. The compaction shall be done with a tractor weighing at least 17 tons and having cleat and track transport, and the compaction shall consist of one track of the tractor passing over the entire area at least six times."

The fill was built up from 2 to 5 ft above the design grade to expedite settlement. As the fill progressed, a moving loaded truck weighing 34 tons gross would produce little or no vibration nearby, but the vibratory effect of the 17-ton tractor was very noticeable 20 ft or more away. This vibration was very helpful as evidenced by compaction tests made at frequent intervals at depths about 2 ft below the surface. The tests averaged 110 to 115 percent of optimum (by a modified AASHO method).

All slopes were 10:1 or flatter to avoid mud waves.

A test fill 16 ft high was built up in the terminal area between August and November of 1947. Settlement during October and November was at the rate of about 1 in. per week. By March 1948, it was down to $^1/_4$ in. per week, and by 1952 it was negligible. The total settlement of the original swamp was slightly over 2 ft.

Pile foundations were deemed necessary for the main buildings, but the stabilized swamp has been used without piles for runways, terminal apron, auto parking area, and such.

Runway length increased

The advent of the large plane brought about a demand for an increase in the length of the instrument runway. The new general plan of the airport provided for extending this runway in a westerly direction and increasing its length from 5,280 to 7,284 feet. It was also decided to design this runway for 300,000-lb planes.

The site of this extension was excavated to a depth of 4 ft, except in a few areas where the depth was 7 ft. The area was then backfilled with selected granular material placed and compacted in 1-ft layers as previously described. The fill was overloaded to a height of 5 ft above the proposed subgrade to expedite the 1- to $1^1/_2$-ft settlement anticipated. The runway extension was paved with a dry-bound macadam base course 9 in. thick, laid in 3-in. layers with a 3-in. top course of hot asphaltic concrete placed in two layers. Similar construction was used for the taxiways except that the base course was 11 in. thick.

Meanwhile the problem of the maintenance and use of the existing runways had to be considered. No funds were available to completely rebuild them according to modern design concepts. At the same time, there was definite evidence of failure at various points. In addition, the runway surfaces, which had received very little maintenance, began to open up and permit water to reach the subsoil. No subsoil drainage had been provided in the original construction. Because of the need to seal the runways and find some practical method of continuing them in use, a program of resurfacing was started in 1949 and has been continued to date. In this program, a bituminous material ranging in depth from $1^1/_2$ to 10 in. has been placed over old runway surfaces.

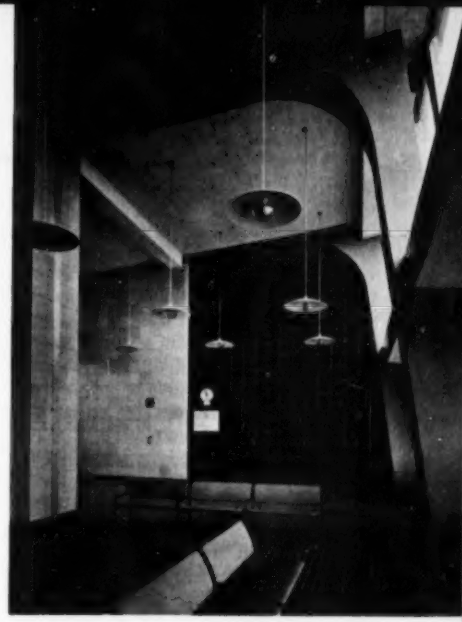
Consolidation of the subsurface under heavy loads, previously described in the design and construction of the fill material for the new terminal building, became evident in another way during the resurfacing of the old runways. These runways had been built with fairly accurate control of the horizontal cross-section and longitudinal elevation. The original design called for a transverse grade of 1 percent or a total rise of 9 in. from the side to the crown of the 150-ft-wide runway. In many cases, the center of the runway was found to have settled until the crown was approximately level with the edge. This settlement definitely evidenced the concentration of plane traffic in the center of the runway. Bituminous material added to varying depth restored both the longitudinal and the transverse profile.

Scheduling of work on the terminal building and its fingers, and the use of the ramp area for building construction purposes, together with the late date when funds became available, made the final job of constructing the ramp for the new terminal building a rush operation. This ramp, built on the densely compacted fill described earlier, is of concrete 12 in. thick doweled at joints in accordance with standard practice. A total of 88,000 sq yd of this pavement was laid and completed by the contractor in 65 working days during the late summer and fall of 1953. To reduce glare on the ramp, $2^1/_2$ lb of carbon black emulsion, per sack of cement, was added to the concrete. The result was a pleasing light gray color.

An interesting innovation in paving, at least in the Philadelphia area, was used in the automobile parking area at the terminal building. The top 6 in.

of the sand and gravel fill was stabilized by adding about 10 percent of fly ash from the Philadelphia Electric Company's power plants, and about 5 percent of hydrated lime, both intimately mixed with the sand until a uniform color was obtained. The 6-in. depth was then alternately wetted by sprinkler wagons and mixed with Pulvi-mixers until optimum moisture was obtained. Next the area was compacted with wobble-wheel rollers, shaped to final grade, and rolled with a heavy flat roller until maximum density was obtained. A tack coat followed, and finally a $1^1/_2$-in. wearing surface of hot, plant-mix bituminous concrete (ID-2) was laid and covered with a seal coat and limestone chips. Altogether, 58,500 sq yd of this pavement was laid.

What does the future hold as far as the development of the field pattern is concerned? Some things are evident. The three-runway pattern has already come into existence, since one of the four runways has been closed for landing and takeoff and is used only for taxiing. It has been proved that three runways are sufficient. It is not too far-fetched to believe that the field may eventually get down to a two-runway, 90-deg pattern for the larger commercial planes.



Waiting room in Terminal Building is finished with 2-in.-thick architectural terra cotta.

A parallel instrument runway, similar to that originally considered by the first designers in 1936, is apparently soon to come. Designs are in process of preparation, and funds are expected to be made available within the next year to begin construction of this runway.

The overall responsibility for design and construction work from 1925 to 1951, inclusive, was vested in the Bureau of Engineering and Surveys in the Department of Public Works of Philadelphia. With the advent of the new City Charter in 1952, and continuing until early in 1954, the same staff of engineers, now in the Water Department, continued as engineers. Starting in 1954, all new projects are under the supervision of the Division of Aviation, Department of Commerce, which department has full responsibility for the airport under the new charter. Many individuals in the city service, and several groups of consulting engineers and architects, have had a part in the development of the airport. These men are too numerous to list here.

Accompanying photographs are used by courtesy of the following: air view of field, Aero Service Corporation; view of hangars, Huges-Foulkrod Co., general contractor; views of completed terminal building, Federal Seaboard Terra Cotta Corp.; and all other views, Official Photographer, Department of Public Works, City of Philadelphia.

(This article has been prepared from the paper presented by Mr. Baxter at the ASCE Atlantic City Convention, before the Air Transport Division session presided over by T. J. Owens, M. ASCE.)

What about collective bargaining?

CHARLES W. YODER, A. M. ASCE

Vice Chairman

ASCE Committee on Employment Conditions

Consulting Engineer, Milwaukee, Wis.

That collective bargaining is a live-wire subject is shown by the fact that two addresses dealing with it were included in the general session of ASCE's Atlantic City Convention, one by Mr. Yoder, here printed, and the other by L. Stewart McCoy, a Junior Member, which appeared in the July issue. This session was sponsored by the Society's Committee on Conditions of Practice, and presided over by the committee's chairman, G. Brooks Earnest. Of help to those interested in this subject is the memorandum, "Engineers, Unionization and the Tax Status of ASCE," available on request from ASCE Headquarters.

With eyebrows raised, some seem to be surprised by any headline that links collective bargaining with the engineering profession. Although many of us may not have come in contact with the problem of collective bargaining, we've read of it, we've argued about it. Whatever we may say about it, it seems to me that we should not be surprised by it.

When the climate is right, a seed will germinate and sprout. It matters little where on the earth's surface the seed is cast—when the climate is favorable, the plant will grow. So too it is with ideas. When the climate is right, ideas will grow and take physical form—even collective bargaining among engineers. I'd like to discuss here several important factors which, in my opinion, provide the right climate for collective bargaining.

First, however, I want to emphasize that I'm not going to argue the case for collective bargaining. I'm going to report facts—facts that have come to the attention of the Society's Committee on Employment Conditions. I shall report on facts, not prejudice or emotion. For the record, I was an employee—now I'm an employer.

Going back to the climate required for collective bargaining, last fall Society members received a questionnaire whose sole purpose was to learn what they thought about collective bargaining. From the answers received, four important factors emerge which seem to constitute the climate favorable for the growth of collective bargaining. These

are not the only factors; the subject is complex like the whole atmosphere surrounding employment conditions for professional engineers today. The four factors I shall mention may not be the chief climate-makers in some areas, but they exist in whole or in part in most areas where collective bargaining has entered the engineering field. The order in which I discuss them seems to be that of their proper importance.

First, union pressure

First—union pressure. This is a climatic condition beyond our control. We haven't sought it, we didn't make it, and, I suspect, we can't stop it. By union pressure I mean the pressure of craft, trades, and factory unions on professional engineers. Mr. McCoy has spelled out in detail how union pressure was exerted on him. (See his article in the July 1954 issue.) Incidentally, there is nothing new about an attempt to unionize civil and other professional engineering employees. As far back as World War I, movements toward this end have waxed and waned, generally in direct relation to the economic health of the country.

The passage of the Wagner Act in 1935 raised the curtain on the latest series of chapters. Apparently there was no realization of its impact on engineer employees. But employed engineers were just as much employees in the eyes of the law as were carpenters, plumbers, or any other workers, and they were similarly subject to the provisions of the Wagner Act.

The established labor unions were quick to take advantage of the situation, and it was not long before professional employees, in many instances, found themselves included with other classes of employees in organizations not to their liking. Labor leaders who had little understanding of the needs and objectives of professional people, and even less concern about them, soon were serving as official representatives of engineer employees in collective bargaining negotiations with their employers.

Taking cognizance of that pressure on its members, our Society formed a "Committee on Unionization" as early as 1937 with instructions to explore the whole matter and consider what measures should be undertaken. That committee and its successors (Committees on Employment Conditions) did a major job of pioneering in a field that was new and strange to the engineering profession.

The course followed by the American Society of Civil Engineers during the 1937–1946 period was a hectic one. At this late date it is a bit difficult to appreciate the magnitude and fervor of the storm that raged. The Society was subjected to scorn and ridicule. It was accused of trying to become a glorified labor union. No other engineering society appeared to have the courage or understanding of the problem necessary to undertake action.

Through it all, the ASCE Board of Direction and its Committee on Employment Conditions stuck to the job before them, and when the time finally came, had developed a definite course of action. In 1946, the election of the Republican 80th Congress brought the certainty that the Wagner Act would be overhauled.

The ASCE Board of Direction, with nearly 10 years of background study and experience, formally adopted its now-famous three-point statement of policy, briefly as follows:

1. Professional employees should have the right to form and administer their own bargaining unit.
2. Professional employees should not be forced to join a bargaining group which includes non-professionals.
3. No professional employee should be forced to join a union as a condition of his employment.

By this time, the other constituent societies of EJC came to a better understanding of what the ASCE had been doing in this field for ten years. EJC formally adopted the same statement of policy. Also, EJC appointed a Labor Legislation Panel and enlisted the cooperation of ASEE and NSPE. After much effort and careful handling, the panel was able to have the so-called "professional employee" provisions incorporated in the Taft-Hartley Act.

The essence of the professional employee provisions is that a group of professional employees, in any place of employment, may decide by majority vote of their own members whether they want to form a unit of their own for collective bargaining purposes, to join with some other bargaining group, or to refrain from any action of the sort. At last, professional employees had statutory protection. That is where we are today.

May I emphasize that the protection provided by the Act, although adequate, is not automatic. Professional engineers, including pre-professionals, are required to take positive action in accordance with established and fairly complex legal and administrative procedures. The basic pattern is well stated in the recent memorandum, "Engineers, Unionization and the Tax Status of ASCE" (obtainable on request from ASCE Headquarters).

Today, however, the protective provisions of the Act may not apply in a growing number of situations. Early administration of the Act was carried out with a liberal interpretation as to its coverage. Now a new NLRB policy is unfolding, which will substantially narrow its activity. In this new emphasis, those labor cases which do not affect interstate commerce may be exempt from the board's jurisdiction. This will force professional employees to fall back on the provisions of existing state laws if they are to resist the encroachment of craft unions into the professional level. The full meaning of these complications cannot be clarified. It would appear that this element of climate will continue to favor the growth of collective bargaining.

Second, economic pressure

The second climatic condition is economic pressure, or just plain MONEY. In our review of the results of the survey, the influence of relative income or lack of it was unmistakable. When 40 percent of the Society's members are not now opposed to collective bargaining and 25 percent are looking forward to this means of improving their income position, it is not a case of external union pressure alone.

A bit of perspective will clarify this factor. According to reliable reports, last year's crop of graduate civil engineers received starting salaries that ranged just over \$350 per month, or around \$2.05 per hour for a 40-hour week. This year's class may be doing slightly better. If they average \$360 per month, their hourly rate equivalent would be \$2.08 per hour. For entrance salaries, today's civil engineer graduates are benefiting by the law of supply and demand. The salary curve has been rising in their favor since the end of World War II. Incidentally, there are few of us of prewar vintage who started as well.

Many of these graduates will go into the construction field. There they will find income comparisons like these. In Philadelphia, for example, the union laborer (no special training or apprenticeship required) gets \$1.95 per hour if in building construction and \$2.25 per hour if in heavy construction. In other trades, what does he find? Let's take several that require some period of apprenticeship—say, a period that may approach the civil engineer graduate's four years in college. Carpenters: \$3.20

per hour, or $555 per month; plasterers: $3.55 per hour, or $615 per month; bricklayers: $3.92 per hour, or $680 per month. These are all straight time rates—no overtime. In the case of the plasterers, that's for a 7-hour day!

Many of us have brushed off these high union rates with the answer that those crafts don't enjoy a full work year, year after year. I can't speak for Philadelphia averages, but in Milwaukee many of the bricklayers are doing fairly well on that score. Not all the Florida-bound Milwaukeeans in the winter come from the executive and administrative ranks!

Let's carry the comparison one step further. A bricklayer earning $680 per month straight time in Philadelphia has a higher income—if the "positions vacant" columns are any indication—than many designers who have ten years of full design experience plus a varying number of years of postgraduate, predesigner experience. As a matter of fact, the bricklayer's income compares favorably with that of some engineering executives.

Let me point out here that the engineer does not stand alone in this unfavorable economic picture. He is a part of the great white-collar group. Economists and historians trace in the past twenty years the relation between the rise in economic position of skilled and unskilled labor with the increase in unionization. Other factors favorable to the growth of unions have also existed. Nevertheless, the relative economic disadvantage of the unorganized white-collar workers during that period is unmistakable.

The employer members of the Society find themselves in an anomalous position. No matter how much they may try to improve the earnings of their employees, they work for management that too often assumes engineering costs are overhead and non-productive. Ask any railroad bridge engineer if you don't understand that language!

The root of this problem is deep; it's the familiar "how to increase the respect—and the pay—accorded us by the public in general, and our clients in particular."

Third, large organizations

Now for the third point. Another condition or place which is a favorable breeding ground for collective bargaining is the large organization employing sizeable numbers of engineers. The survey clearly indicated that opposition to collective bargaining is highest among those in private practice and lowest among those in government service and industry. Conversely, opinion favoring collective bargaining runs highest among engineers in government service and in industry.

Let's stop here for a moment. I sincerely believe that the average engineer: (1) is a rugged individualist, (2) dislikes regimentation such as unionization, (3) prefers to advance on his own merits, and (4) prefers the rewards of self-expression, not only in dollars but in recognition.

In other words, there's no doubt in my mind that most of us are in this profession because we are professional people at heart. Goodness knows, there are lots of other jobs where a man can make a living more easily. But we like the challenge of creativity, the challenge of solving the difficult, the challenge of standing on our two feet as free and independent men—taking the rewards as well as the heartaches. Sure, we'd like to make an adequate income, but many engineers are motivated by other drives besides money. It seems to me that self-expression is a very, very strong drive for our kind of people.

Self-expression—what chance has the engineer to realize it in the large organization? Does he see the guy who makes the final decision? Does he have any chance to discuss his ideas in the assembly where the "product" is born? Actually, does the boss know him? Recently, after an ASCE meeting, a Junior member, discussing the subject of employment conditions with me, said, with disarming candor, "You know, although I have worked for Mr. — for seven years, I don't believe he knows the face that goes with my name!" Not a large organization either—only 10 men in it.

We all know of large industries that employ over 25 engineers in one room, of public bodies employing similar and larger numbers. We also have "blueprint factories" in the consulting engineering field. Should we be surprised, when individual relationships are lost in the large group, that the individual professional engineer becomes tempted by group methods or by collective bargaining?

Fourth, slower advancement

My fourth and last point is related to the previous one. It is that in some areas advancement in the profession today is slower than it was in earlier generations. This is most apparent in the larger organizations.

Closely related to this point is one of the common conditions in large organizations—the problem of great specialization. Specialization becomes valuable to the efficient operation of a large group. To the individual, however, in so far as it retards full self-expression, it leads to narrowness and monotony. If to these you add a slower rate of advancement, the end product is individual frustration and dissatisfaction. This is a breeding ground for unionization.

What should be our policy?

Many arguments have arisen as to what should be our policy on collective bargaining. One respondent writes in to say that if the Society does anything favorable about collective bargaining he will quit. Another of equally good standing says that unless something is done to improve his economic status he will resign!

What is our policy to be? That question deserves careful study, group discussion, and sober judgment. It seems to me we should be alert to the issues and conditions of employment affecting our membership. Above all, we must face the issues objectively, without prejudice or emotion. To date our policy has been designed not for the purpose of stimulating collective bargaining by engineers, but rather to provide a means for engineers to use in protecting themselves against the inroads of labor unions.

We should recognize the other climatic features in our employment conditions, features over which we may have some control. The matter is as simple as this: interest in collective bargaining by engineers will vary inversely with satisfactory employment conditions. Where salaries lag, or where the actual conditions of employment cease to permit self-expression, interest in collective bargaining will increase.

If we wish to minimize interest in collective bargaining we must promote the proper climate. There is work for all of us, employer or employee. Employers can help by examining their own policies, to see that professional employees are accorded proper consideration. Employees need to remember that you can't have your cake—professional recognition—and eat it too.

As members of ASCE we should study the question of employment conditions, discuss it, look around to see how the other fellow works. Conditions of employment have changed; it may be later than you think. Keep your Section alert to its opportunities for service in this field.

1954 Annual Convention

New York, N. Y. Statler Hotel October, 18–22, 1954

REGISTRATION

Convention Rotunda, Statler Hotel

Opens 9:00 a.m., Monday, October 18; each Convention day 9:00 a.m. to 5:00 p.m.

Registration fee $2.50 (except ladies and students).

ADVANCE REGISTRATION

To assure adequate preparation to make your attendance at the Annual Convention most satisfactory, the Committee requests your assistance.

It will be most helpful to have guidance in the number of persons to be expected for the various functions. Will you please use the coupon on page 116, which is to be sent to J. M. Garrelts, Convention Chairman?

It is not necessary to send a check covering all events. The only event for which advance payment is required is the Dinner-Dance on October 20, as detailed in the program. If you wish, you can send your check to cover all tickets and the registration fee.

Your help with this advance registration will measurably facilitate the planning of the Committee.

AUTHORS' BREAKFASTS

East Room **Statler Hotel**

8:15 a.m. each morning

Briefing sessions for speakers, discussers and program officials by invitation. Presiding: John R. Zehner, Vice Chairman, Annual Convention Committee.

MONDAY MORNING OCT. 18

Engineering Mechanics Division

9:30 a.m. **Keystone Room**

Presiding: Ralph Fadum, Chairman, Executive Committee, Engineering Mechanics Division

9:30 **Non-Linear Beam Deflections**
H. C. Martin, Dept. of Aeronautical Engineering, Univ. of Washington, Seattle, Wash.

10:15 **Lateral Stability of Frames**
E. F. Masur, Professor of Civil Engineering, Illinois Inst. of Technology, Chicago, Ill.

11:00 **Sheetpile Bulkhead Deflections**
F. E. Richart, Jr., M.ASCE, Associate Professor of Civil Engineering, Univ. of Florida, Gainesville, Fla.

11:30 **Discussion**

Power Division

9:30 a.m. **West Room**

Presiding: R. A. Sutherland, Member, Executive Committee, Power Division

9:30 **Life Expectancy of Steam Plant Equipment**
J. J. Reilly, A.M.ASCE, Appraisal Engineer, Ebasco Services, New York, N. Y.

10:00 **Discussion**

10:15 **Civil Engineering Features of East 74th St. Power Plant, New York**
M. P. Aillery, M.ASCE, Structural Engineer, J. G. White Engineering Corporation, New York, N. Y.

10:45 **Discussion**

11:00 **Site Development for E. F. Barrett Power Station**
W. Welch, Assistant Vice President, Long Island Lighting Company, New York, N. Y.

Sanitary Engineering Division

9:30 a.m. **Ballroom**

Presiding: B. A. Poole, Chairman, Executive Committee, Sanitary Engineering Division

Ross E. McKinney, J.M.ASCE, Assistant Professor of Civil Engineering, Massachusetts Institute of Technology Cambridge, Mass.

Ray L. Derby, M.ASCE, Principal Sanitary Engineer, City Department of Water & Power, Los Angeles, Calif.

9:30 **Meeting opened by Chairman, Sanitary Engineering Division**
B. A. Poole, M.ASCE, Chief Engineer, Indiana State Dept. of Health, Indianapolis, Ind.

9:35 **Activities of Joint Committee on the Advancement of Sanitary Engineering**
Earnest Boyce, M.ASCE, Chairman, Civil Engineering Dept., University of Michigan, Ann Arbor, Mich.

9:55 **Discussion**

10:05 **Forum—Certification of Sanitary Engineers**

Forum Leader

Rolf Eliassen, M.ASCE, Chairman, Sanitary Engineering Div., Dept. of Civil Engineering, Massachusetts Inst. of Technology, Cambridge, Mass.

Forum Panel

Earnest Boyce, M.ASCE, Chairman, Civil Engineering Dept., Univ. of Michigan, Ann Arbor, Mich.

B. A. Poole, M.ASCE, Chief Engineer, Indiana State Dept. of Health, Indianapolis, Ind.

Alvin F. Meyer, Jr., M.ASCE, Lt. Col. USAF (MSC), Fairborn, Ohio.

W. A. HARDENBERGH, M.ASCE, President, Public Works Journal Corp., New York, N. Y.

RAY E. LAWRENCE, M.ASCE, Black & Veatch, Kansas City, Mo.

HAROLD B. GOTAAS, M.ASCE, Prof. of Sanitary Engineering, and Director, Sanitary Engineering Research Laboratories, Univ. of California, Berkeley, Calif.

Committee Reports

11:20 **Sanitary and Storm Sewer Design and Construction Manual of Practice**

BERNAL H. SWAB, M.ASCE, Consulting Engineer, Oklahoma City.

11:40 **Sewerage and Sewage Treatment**
K. L. MICK, M.ASCE, Chief Engr. and Supt., Minneapolis, St. Paul, Sanitary District, St. Paul, Minn.

Surveying and Mapping Division

9:30 a.m. **Skytop**

9:30 **Plane Coordinates for Industrial Sites**

MAX O. LAIRD, M.ASCE, Overseas Equipment Engineer, American Telephone & Telegraph Co., New York, N. Y.

10:15 **An Industry Puts the Texas Coordinate System to Work**

HAROLD P. COOPER, J.M.ASCE, Utilities Projects Engineer, The Dow Chemical Co., Freeport, Tex.

11:00 **A New Look at the Specifications for Federal Geodetic Control Surveys**

ROBERT H. RANDALL, M.ASCE, Asst. on Cartography, U. S. Bureau of the Budget, Washington, D. C.

EMPLOYERS-EMPLOYEES LUNCHEON

Monday, Oct. 18, Georgian Room

Sponsored by the Committee on Junior Members and the Metropolitan Section Junior Branch

Speaker: CARL B. JANSEN, M. ASCE, President, Dravo Corporation

Subject: Construction—an Engineer's Challenge

Toastmaster: G. BROOKS EARNEST, Chairman, Committee on Conditions of Practice, Vice President ASCE.

This luncheon will keynote a session running through the afternoon discussing the basic relationship between employers and their young engineer employees. All members, guests and friends of ASCE are cordially invited to attend this luncheon, sharing the topic of timely concern to the profession.

MONDAY AFTERNOON OCT. 18

Conditions of Practice Session

2:30 p.m. **Georgian Room**

Presiding: Jewell M. Garrelts, Chairman, Committee on Junior Members.

Sponsored by the Committee on Junior Members, J. M. Garrelts, Chairman, and the Metropolitan Section Junior Branch, Eugene D. Jones, President.

2:30 **The Young Engineer in Construction**
DWIGHT W. WINKELMAN, M.ASCE, President, D. W. Winkelman Co., Inc., Syracuse, N. Y.

2:50 **The Young Engineer Looks at His Economic Position**

WILLIAM C. CARROLL, J.M.ASCE, Junior Civil Engineer, State Dept. of Public Works, Los Angeles, Calif.

3:10 **Junior Members Seek Recognition for Their Ability and Effort**

ROBERT M. OLSON, J.M.ASCE, Houston, Tex.

3:30 **Civil Engineering—a Career**
ELMER K. TIMBY, M.ASCE, Partner, Howard, Needles, Tammen and Bergendoff, New York, N. Y.

4:00 **General discussion**

Engineering Mechanics Division

2:30 p.m. **Keystone Room**

Presiding: Paul F. Chenea, Chairman, Committee on Elasticity, Engineering Mechanics Division

2:30 **Plastic Torsion by Analog Computers**

JEROME H. WEINER, Asst. Prof. of Civil Engineering and Eng. Mech., Columbia Univ., New York, N.Y.

M. G. SALVADORI, M.ASCE, Professor of Civil Engineering, Columbia Univ., New York, N. Y.

VICTOR PASCHKIS, Adjunct Assoc. and Prof. of Mech. Eng., Columbia Univ., New York, N. Y.

3:15 **Impact on Trusses**

B. BOLEY, Professor of Civil Engineering, Columbia Univ., New York, N. Y.

C. C. CHAO, Research Asst., Dept. of Civil Engineering and Eng. Mech., Columbia Univ., New York, N.Y.

4:00 **Domes under Dead Load**

J. V. HUDDLESTONE, J.M.ASCE, Civil Engineering Dept., Columbia Univ., New York, N. Y.

M. G. SALVADORI, M.ASCE, Professor of Civil Engineering, Columbia Univ., New York, N. Y.

Power Division

2:30 p.m. **West Room**

Presiding: R. A. Sutherland, Member, Executive Committee, Power Division

2:30 **McNary Hydroelectric Development**

F. S. TANDY, M.ASCE, Col., Corps of Engineers, Walla Walla District, Walla Walla, Wash.

3:00 **Discussion**

3:30 **Foundation Problems of Kerr No. 3 Hydroelectric Development**

H. H. COCHRANE, Consulting Engineer, Montana Power Co.; and R. A. SUTHERLAND, M.ASCE, Civil Engineer, Ebasco Services, New York, N. Y.

4:00 **Discussion**

Sanitary Engineering Division

2:00 p.m. **Ballroom**

Sewerage and Sewage Treatment

Presiding: Roy J. Morton, Member, Executive Committee, Sanitary Engineering Division

John J. Baffa, M.ASCE, Consulting Engineer, New York, N. Y.

Kerwin L. Mick, A.M.ASCE, Chief Engineer and Supt., Minneapolis-St. Paul Sanitary District, St. Paul Minn.

2:00 **Infiltration Measurements in Sewers of Small Size**

ROBERT A. LINCOLN, M.ASCE, Partner, Bogert-Childs, Consulting Engineers, New York, N. Y.

2:15 **Discussion**

2:25 **Engineering Problems Resulting from the Sulphur Cycle**

BROTHER JOSEPH MCCABE, A.M. ASCE, Head, Civil Engineering Dept., Manhattan College, New York, N. Y.; ROLF ELIASSEN, M. ASCE, Prof. of Sanitary Engineering, MIT, Cambridge, Mass.

2:45 **Discussion**

2:55 **Performance of Deep-Water Diffusers for Dispersal of Sewage Effluents in Sea Water**

A M RAWN, M.ASCE, Chief Engineer and General Manager; and F. R. BOWERMAN, A.M.ASCE, Division Engineer; County Sanitation Districts of Los Angeles, County of Los Angeles, Calif.

3:25 **Discussion**

3:40 **Thermophillic Sewage Sludge Digestion at Hyperion Treatment Plant**

WILLIAM F. GARBER, A.M.ASCE, Laboratory Director, Sewage Treatment Div., Bureau of Sanitation, Los Angeles, Calif.

4:00 **Discussion**

4:15 **Photosynthesis in Sewage Treatment**

WILLIAM J. OSWALD, J.M.ASCE, Asst. Research Engineer, Univ. of California, Berkeley, Calif.; HAROLD B. GOTAAS, M.ASCE, Prof. of Sanitary Engineering and Director, Sanitary Engineering Research Laboratories, Univ. of California, Berkeley, Calif.

4:35 **Discussion**

KICKOFF PARTY

Monday, Oct. 18

Cocktails, prizes, entertainment
5:30–7:00 p.m. Penn Top

First general gathering of the Convention for all members and their wives. Tickets for admission without charge to all registered, courtesy of the Hospitality Committee of the Metropolitan Section.

Café Rouge Dinner and Dancing
7:30–10:30 p.m. Café Rouge

An unusual opportunity for an all ASCE evening in the Statler's famed Café Rouge. The Manager has made special reservation for ASCE tables. Tickets, available to all who register for the Convention, will waive the cover charge for dinner-dancing and entertainment. Dinners are "Dutch treat." When your table group has been selected, Captain Fisher of the Café Rouge will make your reservation, if you mention the ASCE Convention. Music by the Dorsey Brothers.

TUESDAY MORNING

OCT. 19

Engineering Mechanics Division

9:30 a.m. Keystone Room

Presiding: Mario G. Salvadori, Chairman, Committee on Mathematical Methods, Engineering Mechanics Division

9:30 **Dynamic Analysis of Elastic-Plastic Structures with the Differential Analog Computer**

L. SCHENKER, M.ASCE, Hydro-electric Power Commission of Ontario, Toronto, Canada.

G. MARTIN, Prof. of Civil Engineering, Univ. of Michigan, Ann Arbor, Mich.

10:00 **Buckling in the Elasto-Plastic Range**

V. FRANCIOSI, Prof. of Engineering, Univ. of Naples, Naples, Italy.

10:30 **Lateral Buckling of Rolled Steel**

R. A. HECHTMAN, A.M.ASCE, Associate Prof. of Structural Research, Univ. of Washington, Seattle, Wash.

J. S. HATTRUP, J.M.ASCE, Structural Engineer, Corps of Engineers, Portland, Ore.

J. H. TIEDEMANN, Harrisburg, Pa.

E. F. STYER, Seattle, Wash.

11:00 **Lateral Buckling of Elastically End-Restrained I-Beams**

W. J. AUSTIN, J.M.ASCE, Research Asst. Prof., Dept. of Civil Engineering, Univ. of Illinois, Urbana, Ill.; S. YEGIAN, Research Asst.; T. P. TUNG, Research Asst. Prof.

Power Division

9:30 a.m. West Room

Presiding: R. A. Sutherland, Member, Executive Committee, Power Division

9:30 **Spillway and Water Control Gates**

D. A. BUZZELL, M.ASCE, U. S. Corps of Engineers, Washington, D. C.

10:00 **Hydroelectric Development in Greece**

W. S. MERRILL, M.ASCE, Civil Engineer, Public Power Corporation, Athens, Greece.

10:30 **Technicolor, sound film**

Kemano Project.

Sanitary Engineering Division

9:30 a.m. Ballroom

Water Resources

Presiding: Ralph E. Fuhrman, Member, Executive Committee, Sanitary Engineering Division

Robert D. Mitchell, M.ASCE, Partner, Malcolm Pirnie Engineers, New York, N. Y.

9:30 **Water Treatment Plant Design—Manual of Practice, Committee Report**

RAY L. DERBY, M.ASCE, Principal Sanitary Engineer, City Dept. of Water and Power, Los Angeles, Calif.

9:40 **Discussion**

9:45 **Hudson River Water, Its Characteristics and Treatment**

RICHARD HAZEN, M.ASCE, Partner, Hazen & Sawyer, New York, N. Y.

10:15 **Discussion**

10:25 **Preparation of Pepacton Reservoir Area for Flooding**

Stanley M. Dore, M.ASCE, Deputy Chief Engineer, Board of Water Supply, New York, N. Y.

10:45 **Discussion**

10:55 **Studies of Sea Water Intrusions in Delaware Estuary**

Vincent G. Terenzio, M.ASCE, Division Engineer, Research and Development Dept., Board of Water Supply, New York, N. Y.

11:15 **Discussion**

11:25 **Conservation of Ground Water on Long Island, New York**

ARTHUR H. JOHNSON, M.ASCE, Associate Engineer, New York State Water Power and Control Commission, Jamaica, N. Y.

11:45 **Discussion**

11:50 **Sanitary Engineering Aspects of Nuclear Energy Committee Report**

CONRAD P. STRAUB, A.M.ASCE, Senior Sanitary Engineer, Robert A. Taft Sanitary Engineering Center, Public Health Service, Oak Ridge National Laboratory, Oak Ridge, Tenn.

12:10 **Discussion**

Waterways Division

9:30 a.m. East Room

Presiding: Carl B. Jansen, Chairman, Exective Committee, Waterways Division

9:30 **Design of Modern Cargo Piers**

FRANCIS W. HERRING, M.ASCE, Chief, Planning Division, Port of New York Authority, New York, N. Y.

10:00 **Channel Depths for Modern Ports**

B. B. TALLEY, M.ASCE, Colonel, U.S. Army, Division Engineer, North Atlantic Div., Corps. of Engineers, New York, N. Y.

10:30 **Protection and Rehabilitation of Beaches by Artificial Nourishment**

JAY V. HALL, A.M.ASCE, Chief;

ST. LAWRENCE SEAWAY LUNCHEON

Tuesday, Oct. 19

12:30 p.m. Georgian Room

Sponsored jointly by the Waterways, Hydraulics, and Power Divisions

Speaker: BRIG. GEN. E. C. ITSCHNER, M.ASCE, Asst. Chief of Engineers for Civil Works, U.S. Army, Washington, D. C.

Subject: The St. Lawrence Seaway and Power Project

Presiding: CARL B. JANSEN, Chairman, Waterways Division

For this subject of general concern to all engineers, and the general gathering, all members, guests and friends of ASCE are cordially invited to attend.

and G. M. WATTS, J.M.ASCE, Asst. Chief; Engineering Div., Beach Erosion Board, Washington, D.C.

11:00 **Film: Via Port of New York**

Structural, Highway Divisions—Joint Session

9:30 a.m. — **Skytop**

9:30 **The Delaware River Suspension Bridge at South Philadelphia**
HOMER SEELY, M.ASCE, Project Engineer, Modjeski & Masters and Ammann & Whitney, Camden, N.J.

10:00 **Structures on Holland Tunnel Extension, New Jersey Turnpike**
ELLIS PAUL, M.ASCE, Partner, Howard, Needles, Tammen & Bergendoff, New York, N.Y.

11:00 **Kingston-Rhinecliff Cantilever Bridge Across Hudson River**
D. B. STEINMAN, M.ASCE, Consulting Engineer, New York, N.Y.

11:30 **New York Central Lift Bridge Across Harlem River**
ROBERT CRANE, M.ASCE, Asst. Chief Engineer, N.Y. Central Railroad, New York, N.Y.

TUESDAY AFTERNOON OCT. 19

Hydraulics Division

2:30 p.m. — **West Room**

Symposium on Tidal Hydraulics

Presiding: G. H. Hickox, Chairman, Executive Committee, Hydraulics Division

2:30 **Basic Considerations**
C. F. WICKER, A.M.ASCE, Chief of Engineering Div., Philadelphia District, Corps of Engineers; Chairman, Committee on Tidal Hydraulics.

3:00 **Tides and Currents Along U. S. Coasts**
J. M. CALDWELL, A.M.ASCE, Chief, Research Div., Beach Erosion Board, Corps of Engineers; and LINDSEY P. DISNEY, A.M. ASCE, Asst. Chief, Div. of Tides and Currents, U.S.C. & G.S.

3:30 **Engineering Problems in U.S. Tidal Waterways**
J. H. DOUMA, A.M.ASCE, Structures Branch, Engineering Div., Civil Works Office, Chief of Engineers, U. S. Army.

Theory and Dynamics

4:00 **Computation of Tides and Tidal Currents, U.S. Practice**
H. A. EINSTEIN, A.M.ASCE, Assoc. Prof. of Mechanical Engineering, Univ. of California, Berkeley, Calif.

Sanitary Engineering Division

2:00 p.m. — **Ballroom**

Presiding: Richard Hazen, Member, Executive Committee, Sanitary Engineering Division

Arthur J. Fox, Jr., A.M.ASCE, Associate Editor, Engineering News-Record, New York, N. Y.

Bernal H. Swab, M.ASCE, Consulting Engineer, Oklahoma City, Okla.

2:00 **Industrial Wastes**

2:00 **Plant for Treating Tannery Wastes Before Discharge to Municipal Sewer**
LINCOLN W. RYDER, A.M.ASCE, Project Engineer, Metcalf and Eddy, Boston, Mass.

2:20 **Discussion**

2:30 **Removal of Color from TNT Wastes**
GAIL P. EDWARDS, M.ASCE, Prof. of Sanitary Chemistry, New York Univ., N. Y.
WILLIAM T. INGRAM, A.M.ASCE, Adjunct Prof., New York Univ., N. Y.

2:50 **Discussion**

3:00 **Soil Percolation Studies for Certain Industrial Wastes**
B. W. DICKERSON, Sanitary Engineer, Hercules Powder Company, Wilmington, Del.

3:20 **Discussion**

3:30 **Forum—Sanitary Engineers in Industrial Waste Practice**

Forum Leader

JOHN E. KINNEY, A.M.ASCE; Sanitary Engineers, Ohio River Valley Sanitation Commission, Cincinnati, O.

Forum Panel

B. W. DICKERSON, Sanitary Engineer, Hercules Powder Company, Wilmington, Del.

WILLIAM S. WISE, M.ASCE, Director of State Water Commission, Hartford, Conn.

EDWIN B. COBB, M.ASCE, Partner, Metcalf and Eddy, Boston, Mass.

A. J. FISCHER, M.ASCE, Development Engineer, The Dorr Company, Stamford, Conn.

DAVID CALDWELL, M.ASCE, Partner, Brown and Caldwell, San Francisco, Calif.

GEORGE DREHER, Chemical Engineer, Jones & Laughlin Steel Company, Pittsburgh, Pa.

ROY F. WESTON, M.ASCE, Sanitary Engineer in Charge of Waste Control, Atlantic Refining Company, Philadelphia, Pa.

Soil Mechanics and Foundations Division

2:30 p.m. — **Skytop**

Symposium on Earth Dams

Presiding: W. J. Turnbull, Member, Executive Committee, Soil Mechanics and Foundations Division

2:30 **Introduction**
W. G. HOLTZ, M.ASCE, Head, Earth Materials Laboratory, U.S. Bureau of Reclamation, Denver, Colo.

2:45 **The Pore Pressure Concept**
T. M. LEPS

3:15 **Influence of Pore Pressure and Consolidation on Laboratory Testing**
D. W. TAYLOR, A.M.ASCE, Soil Mechanics Dept., Mass. Inst. of Technology, Cambridge, Mass.

3:45 **Pore Pressure and Consolidation Observations in Earth Dams on Irrigation and Power Storage Projects**
F. C. WALKER, M.ASCE, Head, Earth Dams Section, U. S. Bureau of Reclamation, Denver, Colo.

4:15 **Consideration of Pore Pressure in the Stabilization of an Ore Pile**
KARL TERZAGHI, Hon. M. ASCE, Prof. of Civil Engineering, Harvard Univ., Cambridge, Mass.
R. B. PECK, M.ASCE, Research Prof. of Soil Mechanics, Univ. of Illinois, Urbana, Ill.

4:30 **Discussion**

Structural, Engineering Mechanics Divisions—Joint Session

2:30 p.m. — **Keystone Room**

2:30 **Panel discussion of activities of Column Research Council**
SHORTRIDGE HARDESTY, M.ASCE, Consulting Engineer, Hardesty & Hanover, New York, N.Y., moderator.
Discussers on (1) Steel and Aluminum, (2) Alloys, and (3) Concrete

4:15 **Vibration as It Affects Structures Supporting Rotating Machines**
H. H. BENJES, M.ASCE, Chief, Civil Design Section, Black & Veatch, Kansas City, Mo.

INSPECTION TRIPS

Tuesday Afternoon, Oct. 19

Power Division Tour

74th Street Power Plant of New York City Transit Authority

2:00 p.m. Busses leave 32nd Street door of Statler Hotel, returning approximately at 4:30.
The project is the first stage of a

plant modernization program which has included demolition of a large part of the old generating facilities; the installation of two 450,000-lb per hour steam generators, one 60,000-kw turbine generator, and two 20,000-kw frequency convertors, together with new 60-cycle switching facilities; complete replacement of the existing 25-cycle switching facilities, all auxiliaries and structures; and construction of new coal, oil and ash handling facilities on the East River waterfront.

The J. G. White Engineering Corporation, which is acting as design engineer and supervisor of construction, is sponsoring the inspection trip. Tickets must be purchased at the registration center before 12:30 p.m. Tuesday, October 19. Per person $1.00.

Waterways Division Tour

2:30 p.m. There will be a bus leaving from the hotel to inspect Pier C in Hoboken at the 38th Street Marginal Warf and Pier 57 in Manhattan. Cost per person, $1.25.

SANITARY ENGINEERING DINNER

Tuesday, Oct. 19

6:30 p.m. — **Georgian Room**

Speaker: Kenneth Kramer, Executive Editor, Business Week Magazine

Subject: The Business Outlook

For this evening of special interest to all sanitary engineers, all members, their ladies, guests and friends of ASCE are cordially invited to attend.

CONSULTANTS' DINNER

Tuesday, Oct. 19
Waldorf Astoria Hotel

Annual Dinner of the American Institute of Consulting Engineers

6:45 Cocktails
7:30 Dinner

Presiding: Scott Turner, President, American Institute of Consulting Engineers, New York, N. Y.

Speakers: Alfred P. Sloan, Jr., Chairman of the Board, General Motors Corp., New York, N. Y. The Hon. Herbert Hoover

Engineers who wish to attend should address enquiries as to tickets to the headquarters of the American Institute of Consulting Engineers, 33 West 39th St., New York 18, N. Y.

WEDNESDAY MORNING OCT. 20

Annual Business Meeting of ASCE

10:30 a.m. — **Georgian Room**

Presiding: Daniel V. Terrell, President ASCE

10:30 **Annual Reports:**
By the President
By the Executive Secretary

11:00 **Presentation of Awards**

Norman Medal to Robert H. Sherlock, M.ASCE, Prof. of Civil Engineering, Univ. of Michigan, Ann Arbor, Mich.

J. James R. Croes Medal to Fu-Kuei Chang, A.M.ASCE, Designer. Ammann & Whitney, New York, N. Y.

Thomas Fitch Rowland Prize to A. Warren Simonds, M.ASCE, U. S. Bureau of Reclamation, Denver, Colo.

James Laurie Prize awarded to the late Thomas A. Middlebrooks, A.M.ASCE Chief, Soil Mechanics, Geology and Geophysical Sect., Corps of Engineers, U. S. Army, Washington, D. C.

Arthur M. Wellington Prize to Claude H. Chorpening, M.ASCE, Major General, U. S. Army, Corps of Engineers, San Francisco, Calif.

Collingwood Prize for Junior Members to Vaughn E. Hansen, J.M. ASCE, Research Associate Prof. of Irrigation Engineering, Utah State Agricultural College, Logan.

Construction Engineering Prize of the Construction Division to Samuel D. Sturgis, Jr., M.ASCE, Major General, U. S. Army, Chief of Engineers, Washington, D. C.

J. C. Stevens Award of the Hydraulics Division to W. Douglas Baines, J.M.ASCE, National Research Council, Ontario, Canada.

James W. Rickey Medal of the Power Division, to Julian Hinds, M.ASCE, United Water Conservation Dist., Santa Paula, Calif.

Rudolph Hering Medal of the Sanitary Engineering Division to Ralph S. Archibald, J. M. ASCE, Sales Engineer, Pipe Founders Sales Corp., Boston, Mass.; and Harold A. Thomas, Jr., M.ASCE, Prof. Emeritus of Civil Engineering, Carnegie Inst. of Technology, Pittsburgh, Pa.

Leon S. Moisseiff Award of the Structural Division to Jerome M. Raphael, M.ASCE, Associate Prof. of Civil Engineering, Univ. of California, Berkeley, Calif.

11:30 **Installation of Officers**

Report of Tellers on Ballot Canvass
Installation of Directors
Installation of Vice Presidents
Installation of President
Presidents' Keynote Address
Adjournment for Membership Luncheon

STUDENT CHAPTER CONFERENCE

Wednesday, Oct. 20

2:30 p.m. — **East Room**

Open meeting of students from ASCE Chapters, Faculty Advisers, Contact Members, and others interested in the Student Chapter program of the Society.

The Metropolitan Conference of ASCE Student Chapters is sponsoring this meeting. The program will feature participation of students and practicing engineers.

WEDNESDAY AFTERNOON OCT. 20

City Planning Division

2:00 p.m. — **Penn Top North**

2:00 **Local Planning Procedures Under 1954 Housing Act**

J. W. Follin, M.ASCE, Director, Division of Slum Clearance and

ANNUAL MEMBERSHIP LUNCHEON

Wednesday, Oct. 20 — **12:30 p.m., Ballroom**

Speaker: Dr. Grayson Kirk, President, Columbia University

Subject: The Modern Leonardo

Toastmaster: Jewell M. Garrelts, Chairman, Annual Convention Committee

Honorary Membership Awards: by President Daniel V. Terrell to:

Robert J. Cummins, M.ASCE, Consulting Engineer, Houston, Tex.

Shortridge Hardesty, M.ASCE, Consulting Engineer, New York, N. Y.

Edward P. Lupfer, M.ASCE, Consulting Engineer, Buffalo, N. Y.

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon.

Urban Redevelopment, Housing & Home Finance Agency, Washington, D. C.

2:30 **Contribution of Alleghany Conference to Redevelopment of Pittsburgh Metropolitan Area**

PARK MARTIN, M.ASCE, Executive Director, Alleghany Conference on Community Development and Pittsburgh Regional Planning Association, Pittsburgh, Pa.

3:00 **Providence, R. I.—Case Study in Redevelopment**

D. GRAHAM, A.M.ASCE, Executive Director, Providence Redevelopment Agency, Providence, R. I.

3:30 **The Philadelphia Redevelopment Program**

EDMUND BACON, Director of City Planning, Philadelphia, Pa.

Construction Division

2:00 p.m. **Penn Top South**

The Use of Construction Equipment—Choice, Capacities, Economy

Presiding: Warren N. Riker, District Manager, Raymond Concrete Pile Company, Boston, Mass.; and Walter L. Couse, President, Walter L. Couse & Co., Detroit, Mich.

2:00 D. K. HEIPLE, Chief Field Engineer, LeTourneau – Westinghouse Co., Peoria, Ill.

2:30 WILLIAM B. BICKERSON, Special Representative, Sales Development, Euclid Equipment Co., Cleveland, Ohio.

3:00 E. O. MARTINSON, President, Keehring-Waterous, Ltd., Brantford, Ontario, Canada.

Hydraulics Division

2:30 p.m. **West Room**

Symposium on Tidal Hydraulics

Presiding: R. O. Eaton, Chief Technical Adviser, Beach Erosion Board, Corps of Engineers

2:30 **Computation of Tides and Tidal Currents—European Practice**

J. J. DRONKERS, Chief Mathematician, and J. C. SCHONFELD, Chief Engineer, Central Research Div., The Rijkswaterstaat, The Hague, Netherlands.

3:00 **Circulation Within Estuaries**

D. W. PRITCHARD, Director, Chesapeake Bay Institute, Johns Hopkins Univ., Annapolis, Md.

3:30 **Laws of Salt-Water Flow in Fresh Water**

G. H. Keulegan, National Hydraulics Laboratory, U. S. Bureau of Standards, Washington, D. C.

4:00 **Effect of Upland Discharge on Hydraulics of Estuaries**

H. B. SIMMONS, Chief, Estuaries Section, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss.

Sanitary Engineering Division

2:00 p.m. **Georgian Room**

Presiding: Harold B. Gotaas, Member, Executive Committee, Sanitary Engineering Division
W. T. Ingram, M.ASCE, Adjunct Prof., New York Univ., N. Y.
Francis B. Elder, M.ASCE, Engineering Associate, American Public Health Association, New York, N. Y.

Garbage and Rubbish Disposal

2:00 **Investigation of the Leaching of a Sanitary Landfill**

ROBERT C. MERZ, A.M.ASCE, Associate Prof. of Civil Engineering, Univ. of Southern California, Los Angeles, Calif.

2:20 **Discussion**

2:30 **Incinerator Design in Relation to Air Pollution Control**

WILLIAM S. FOSTER, A.M.ASCE, Engineering Editor, *American City Magazine*, New York, N. Y.

2:50 **Design of the City of Baltimore Incinerator**

ROY H. RITTER, M.ASCE, Partner, Whitman, Requardt & Associates, Baltimore, Md.

3:10 **General discussion**

Air Pollution

3:30 **Comparative Study of Dust Fall in New York City**

MORRIS B. JACOBS, Director, Bureau of Laboratory, Dept. of Air Pollution, New York, N. Y.

JOHN DONOVAN, Instructor, Dept. of Industrial Medicine, New York Univ., N. Y.

4:00 **The Industrial Approach to Air Pollution Control.**

WILLIAM R. CHALKER, Engineering Service Div., E. I. du Pont de Nemours Co., Wilmington, Del.

4:30 **Air Pollution Control Activities of State Agencies**

RICHARD L. WOODWARD, A.M.ASCE, Senior Sanitary Engineer, U. S. Public Health Service, Cincinnati, Ohio

4:50 **Discussion**

Soil Mechanics and Foundations Division

2:30 p.m. **Skytop**

Symposium on Earth Dams

Presiding: Hibbert Hill, Member, Executive Committee, Soil Mechanics and Foundations Division

2:30 **Influence of Hydrological Factors on Earth Dam Design**

F. C. WALKER, M.ASCE, Head, Earth Dams Section, U. S. Bureau of Reclamation, Denver, Colo.; and H. W. TABOR, A.M.ASCE, U. S. Bureau of Reclamation, Denver, Colo.

3:00 **Embankment Design Influenced by River Diversion Plans**

W. E. COLLINS, M.ASCE, Asst. Head, Earth Dams Section, U. S. Bureau of Reclamation, Denver.

3:30 **Use of Materials From Structural Excavations**

J. W. HILF, A.M.ASCE, U. S. Bureau of Reclamation, Denver.

4:00 **Limited-Service Spillways**

A. H. COCHRAN, M.ASCE, Chief, Hydrology and Hydraulics Branch, Engineering Div., Office of Chief of Engineers, U.S. Army, Washington, D. C.; and G. R. BERTRAM, Engineer, Office of Chief of Engineers, Washington, D. C.

Structural Division

2:30 p.m. **Keystone Room**

2:30 **Bolted Connections—Research**

WILLIAM MUNSE, J.M.ASCE, University of Illinois, Urbana, Ill.

3:00 **Bolted Connections—Applications**

MACE BELL, A.M.ASCE, Asst. to Director of Engineering, American Institute of Steel Construction, Inc., New York, N.Y.

3:30 **Welded Connections—Research**

LYNN BEEDLE, A.M.ASCE, Asst. to Director, Fritz Eng. Laboratory, Lehigh Univ., Bethlehem, Pa.

4:00 **Welded Connections—Applications**

LAMOTTE GROVER, M.ASCE, Welding Engineer, Air Reduction Co., New York, N.Y.

ANNUAL DINNER AND DANCE

Wednesday Evening

6:30 **Assembly and cocktails, Rotunda**
Cocktails courtesy of Hospitality Committee, Metropolitan Section.

7:30 **Dinner, Ballroom**

9:00 **President's Reception and dancing**

Dinner, music, dance music, entertainment.

For this social evening, special arrangements can be made for the reservation of tables seating 10 persons. Members may underwrite complete tables, or pool reservations with others. Orders for tables must be accompanied by check in full and list of guests.

The published seating list will close at 5:00 p.m. Tuesday, October 19. Tickets purchased after that hour will be assigned to tables in order of purchase. Sale of tickets will be limited to capacity of the Ballroom. Formal dress.

THURSDAY MORNING

OCT. 21

Construction Division

9:30 a.m. Penn Top South

First Session Sponsored by Committee on Pipelines

10:00 **Colored sound movie, "Construction of Lakehead Pipeline and the Crossing of Mackinac Straits"**
S. D. Bechtel, Jr., A.M.ASCE, Manager, Pipeline Division, Bechtel Corporation, San Francisco, Calif.

10:45 **Discussion**

11:00 **Economic and Engineering Studies for Pipeline Financing**
K. W. Reece, M.ASCE, Vice President, Ebasco Services Inc., New York, N. Y.
Charles J. Hodge, Partner, Glore Forgan & Co., New York, N. Y.

11:45 **Discussion**

Highway Division

9:30 a.m. Ballroom

Metropolitan Highways of Tomorrow

Presiding: Edward G. Wetzel, Chairman, Committee on Session Programs, Highway Division.

9:30 **Joint Study of Triborough Bridge and Tunnel Authority and Port of New York Authority**
Roger Gilman, M.ASCE, Director of Port Development, Port of New York Authority.

10:00 **New Jersey's Future in Highways**

10:30 **Westchester County Studies**
James C. Harding, M.ASCE, Commissioner of Public Works, Westchester County, White Plains, N. Y.

11:00 **Discussion**

Hydraulics Division

9:30 a.m. West Room

Symposium on Tidal Hydraulics

Presiding: C. F. Wicker, Chairman, Committee on Tidal Hydraulics, Hydraulics Division

Sediments and Shoaling

9:30 **Composition and Character of Estuarine Sediments in U. S.**
Parker D. Trask, Research Engineer, Inst. of Engineering Research, Univ. of California, Berkeley, Calif.

10:00 **Sources of Shoaling in Tidal Waterways**
R. O. Eaton, A.M. ASCE, Chief Technical Adviser, Beach Erosion Board, Corps of Engineers, Washington, D. C.

10:30 **Flocculation in Estuaries**
U. Grant Whitehouse, Dept. of Oceanography, Agricultural and Mechanical College of Texas, College Station, Tex.

11:00 **Mechanics of Transportation and Deposition of Sediments in Tidal Waterways**
L. G. Straub, M.ASCE, Director, St. Anthony Falls Hydraulic Laboratory, Univ. of Minnesota, Consultant to Committee on Tidal Hydraulics.

Soil Mechanics and Foundations Division

9:30 a.m. Skytop

Symposium on Earth Dams

Presiding: Arthur Casagrande, Chairman, Executive Committee, Soil Mechanics and Foundations Division

9:30 **Seepage through Embankments and Foundations—Comparison of Analytical and Observed Results**

Panel:

F. H. Kellogg, M.ASCE, Dean, School of Engineering, Univ. of Mississippi, University, Miss.

E. E. Esmiol, A.M.ASCE, U. S. Bureau of Reclamation, Denver, Colo.

C. I. Mansur, M.ASCE, Asst. Chief, Embankment and Foundation Branch, U. S. Waterways Experiment Station, Vicksburg, Miss.

11:00 **Open discussion on problems in earth dam engineering**

Structural Division

9:30 a.m. Keystone Room

9:30 **Experience with Prestressing on Lower Tampa Bay Bridge**
Maurice Quade, M.ASCE, Partner, Parsons, Brinckerhoff, Hall & Macdonald, New York.

10:00 **Prestressing in Continuous Structures**
Robert Moorman, M.ASCE, Prof., Chairman, Dept. of Civ. Eng., Syracuse Univ., Syracuse, N.Y.

10:30 **A Survey of Prestressing Practices in Highway Bridges**
John C. Rundlett

11:00 **Pros and Cons of Prestressing**
C. H. Scholer, M.ASCE, Prof., Applied Mechanics, Kansas State Col. of Agric. & Applied Science, Manhattan, Kans.

HIGHWAY PLANNING LUNCHEON

Thursday, Oct. 21

12:30 p.m. Georgian Room

Sponsored by the Highway Division with cooperation of the Construction and Structural Divisions

Speaker: Francis V. duPont, Commissioner, U. S. Bureau of Public Roads.

All members, guests and friends of ASCE are cordially invited to attend and take part in this event devoted to one of the vitally important engineering problems of the day.

THURSDAY AFTERNOON

OCT. 21

Construction Division

2:30 p.m. Penn Top South

Second Session Sponsored by Committee on Pipelines

2:00 **Keynote speech—Pipelines and National Defense**
S. D. Sturgis, Jr., M.ASCE, Major General, U.S.Army, Chief of Engineers, Washington, D.C.

2:45 **Discussion**

3:00 **Engineering Design of Gas Pipeline Projects**
Wm. B. Poor, Manager, Pipeline Construction, Ford, Bacon & Davis, Inc., New York, N. Y.

3:45 **Discussion**

4:00 **Pipeline Committee Meeting**
Eldon V. Hunt, Chairman.

Hydraulics Division

2:30 p.m. West Room

Symposium on Tidal Hydraulics

Presiding: J. B. Tiffany, Member, Executive Committee, Hydraulics Division

Field and Laboratory Investigations

2:30 **Sounding Techniques in Tidal Waterways**
B. B. Talley, M.ASCE, Colonel, Corps of Engineers, Division Engineer, North Atlantic Division, New York, N. Y.

3:00 **Observational Techniques for Field Investigations in Tidal Waterways**
R. F. Rhodes, M.ASCE, Savannah, Ga., Consultant to Committee on Tidal Hydraulics; and E. A. Schultz, A.M.ASCE, Engineering Division, Charleston District, Corp

of Engineers. Both are members of Committee on Tidal Hydraulics.

3:30 **Capabilities of Hydraulic Models**
E. P. Fortson, M.ASCE, Chief, Hydraulics Division, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss.

4:00 **Delaware River Model Studies**
Robert J. Fleming, Jr., Colonel, Corps of Engineers, District Engineer, Philadelphia District, Philadelphia, Pa.

Highway Division

2:30 p.m. — Ballroom

New Developments in Highways

Presiding: Edward G. Wetzel, Chairman, Committee on Session Programs, Highway Division

2:30 **A Look at South America**

3:00 **Modern Toll Collection Facilities**

3:30 **Traffic Diversion to Toll Roads**

Soil Mechanics and Foundations Division

2:30 p.m. — Skytop

Presiding: Ralph B. Peck, Member, Executive Committee, Soil Mechanics and Foundations Division

2:30 **General Aspects of Cement Grouting**
V. L. Minear, M. ASCE, Retired, St. George, Utah.

3:00 **Recommended Cement Grout Practice**
P. C. Sturges.

3:30 **Various Types of Chemical Reactions Employed in Chemical Grouts**
T. W. Lambe, A.M.ASCE, Director, Soil Stabilization Laboratory and Associate Prof. of Soil Mechanics, Massachusetts Inst. of Technology, Cambridge, Mass.

4:00 **Field Experiences with Chemical Grouting**
M. Polivka, A.M.ASCE, Asst. Prof. of Civil Engineering, Univ. of California, Materials Laboratory, Berkeley, Calif.; and L. P. Witte.
John P. Gnaedinger, J.M.ASCE, President, Soil Testing Services Inc., Chicago, Ill.

Structural, Construction Divisions—Joint Session

2:30 p.m. — Keystone Room

2:30 **Thin-Skin Coverings for Buildings**
Philip Drennan and F. S. Merritt, M.ASCE, Assoc. Editor *Engineering News-Record*, New York, N.Y.

3:00 **Analyses of Building Construction Failures**
Jacob Feld, M.ASCE, Consulting Engineer, New York, N.Y.

3:30 **The New York Coliseum**

4:00 **St. Louis Airport Administration Building, an Example of Thin-Shell Construction**

FRIDAY ALL DAY

OCT. 22

City Planning Division

Sponsored by City Planning Division in cooperation with the Lehigh Valley Section, Lehigh University, and Lafayette College

Morning Session

9:00 a.m. — Packer Auditorium
Lehigh Univ., Bethlehem, Pa.

Presiding, Charles A. Blessing, Chairman, Executive Committee, City Planning Division

9:00 **Theory and Development of Nuclear Energy**
John W. Landis, Customer Relations, Atomic Energy Div., The Babcock and Wilcox Co., New York, N. Y.

9:30 **Prospects for Use of Nuclear Power**
H. W. Huntley, Member, Atomic Power Study, General Electric Co., Schenectady, N. Y.

10:00 **Impact of Atomic Development on Growth and Planning of Urban Regions**
Park H. Martin, M.ASCE, Executive Director, Allegheny Conference on Community Development, Pittsburgh, Pa.

10:30 **The Public Safety in Atomic Production**
Arthur E. Gorman, M.ASCE, Sanitary Engineer, U.S. Atomic Energy Commission, Washington, D. C.

11:00 **Prospects for Local Governmenta Structure to Meet Problems of Atomic Development**
Harold A. Alderfer, Prof. of Political Science, Penn State Univ., State College, Pa.

12:00 **Luncheon**
At Country Club of Northampton County, Easton, Pa.

Toastmaster: Francis A. Pitkin, Executive Director, Pennsylvania State Planning Board, Harrisburg, Pa.

Greetings: Dr. Martin D. Whitaker, President, Lehigh Univ., Bethlehem, Pa.

Greetings: Dr. Ralph Cooper Hutchinson, President, Lafayette College, Easton, Pa.

Afternoon Session

2:30-5:30 p.m. — Murphy Auditorium
Lafayette College, Easton, Pa.

Panel Discussion and Open Forum

Presiding: John McNeal III, President, Lehigh Valley Section

Panel Chairman: Cecil F. Dawson, President, Dixie Cup Co., Easton, Pa., and Chairman, Easton Area Planning Coordinating Committee.

Panel Members: Messrs. Landis, Huntley, Martin, Gorman, and Alderfer.

A ladies' program will be arranged.

MEN'S SMOKER AND SHOW

Thursday, Oct. 21

8:00 p.m. — Statler Ballroom

A well earned reputation for informality, excellent entertainment, refreshments to a man's liking, and a chance to swap yarns with old friends, has become attached to this ASCE Smoker.

8–9 p.m. Time to start the evening properly

9–10 p.m. The pick of the talent from Broadway and TV

10 p.m. Sandwiches, snacks, beer and coffee with bar services

Note: To meet the convenience of those attending college dinners, the show has been timed so that there is no need to miss any of the acts. Also note that the ladies are being entertained elsewhere on this same evening, and won't return 'till late!!

Per person $3.50.

Univ. of Illinois Dinner

The University of Illinois Civil Engineering Alumni and their friends will meet for their 27th annual informal dinner at 6:00 p.m. on Thursday evening, Oct. 21, 1954. A private dining room has been reserved at Shine's Restaurant, 424 Seventh Avenue, across the street from the Statler Hotel. Ladies are invited. Dinner will be over in time to attend the ASCE Smoker in the evening. Reservations at four dollars and fifty cents ($4.50) per person should be made as early as possible through Stephen Y. Chin; call WHitehall 3-7980.

Cornell Dinner

Thursday, Oct. 21 **5:30 p.m.**

Engineers Club, 33 W. 39th Street

The Cornell Society of Engineers will meet for a social hour, buffet dinner, and an address. The speaker will be Captain Emil H. Praeger, M.ASCE, and his subject, "Engineering Aspects of the Tappan Zee Bridge."

The time of this meeting has been scheduled to permit attendance at the ASCE Smoker, immediately following. All Cornell engineers and their guests are welcome. For reservations, call William Leonard, Gramercy 3-5600, Ext. 4336.

Sessions of Board of Direction

The ASCE Board of Direction will be in session at the Board Room in the Engineering Societies Building at the following times:

Monday, Oct. 18, 10:00 a.m. to 5:00 p.m.

Tuesday, Oct. 19, 9:30 a.m. to 5:00 p.m.

Thursday, Oct. 21, 2:30 p.m.

LADIES PROGRAM

In addition to tickets which will be available for various radio and television studios, the following special events have been scheduled for the entertainment of ladies attending the Convention.

Monday, Oct. 18

Tickets will be available for the morning show at Radio City Music Hall, to be followed by lunch at the nearby Hotel Taft Grill featuring music by Vincent Lopez. Immediately following the lunch, there will be an opportunity for either a tour of the Radio City facilities or bridge at the headquarter's hotel.

Tuesday, Oct. 19

At 10:00 a.m. busses will leave the hotel for the New York Times building for a one-hour guided tour of the newspaper plant. Lunch will be served in the Times' dining room, following which the busses will deliver the ladies to the Metropolitan Museum of Art. A one-hour guided inspection of a new wing of the museum will exhibit masterpieces in new surroundings.

Wednesday, Oct. 20

At 2:30 in the afternoon, George H. Fitzgerald will speak at the headquarter's hotel on "Fascinating Facts about Gems" and will exhibit rare stones and exotic jewels. Mr. Fitzgerald is a registered gemmologist of the American Gem Society. Comparisons will be made between the natural and the man-made gems. There will be no charge.

Thursday, Oct. 21

Busses will leave the hotel for the U. S. Military Academy at West Point via scenic Hudson River routes, going up the west side of the river and returning on the east side through Westchester County. An inspection of the "Point" will be followed by luncheon at the Officers' Club.

Thursday evening the ladies will be treated to a preview of colored projected pictures of famous homes. Richard Pratt, Architectural Editor of *Ladies Home Journal*, and Mrs. Pratt will show illustrations for his book, *A Treasury of Early American Homes*, to be published this fall. The presentation will be in the form of informal dialogue relating interesting anecdotes associated with the houses and their owners. There will be no charge.

POST-CONVENTION TRIP TO BERMUDA

Leave New York Saturday, Oct. 23

An unusual opportunity to visit a major offshore air installation is offered in a post-convention inspection of Kindley Air Force Base, Bermuda. This tour will combine the opportunity for a brief autumn holiday with the inspection of engineered facilities. New projects at Kindley Base include a power house, sea-water distillation plant, sea wall, and improved storage facilities.

In anticipation that many will wish to enjoy the holiday facilities at Bermuda while making this trip, the trip will be made by air from New York and return, with headquarters in Bermuda at the Hotel Princess. The return to New York will be on Oct. 27, giving five full days in Bermuda. Arrangements can be made for a longer stay if desired.

Cost of the entire tour, including transportation and hotel with meals is $179.85.

Reservations must be made early. Full information pamphlets are available on request from:

Leon V. Arnold
36 Washington Square, W.
New York 11, N. Y.

HOTEL ACCOMMODATIONS

Headquarters of the Annual Convention will be the Hotel Statler, located on Seventh Avenue between 32nd and 33rd Streets, directly opposite, and connected to the Pennsylvania Station. Special arrangements have been made to accommodate many Convention visitors at the headquarters hotel, up to capacity, in the order that reservation requests are received. Send your reservation request early to assure space at the headquarters hotel. For your convenience a special request form is provided on page 116 of this issue. Late requests may have to be assigned to other nearby hotels.

ANNUAL CONVENTION COMMITTEE

Jewell M. Garrelts, *General Chairman*
John R. Zehner, *Vice Chairman*
Raymond K. Brandes, *Past Chairman*
William S. LaLonde, Jr., *Board Contact*

Dinner-Dance
Barclay G. Johnson, *Chairman*
Algert D. Alexis, Elmer K. Timby

Division Lunches
Roger H. Gilman, *Chairman*
Robert H. Dodds, Gardner M. Reynolds

Excursions
Thomas J. Fratar, *Chairman*
Edward J. McGrew Jr., Emil A. Verpillot

Kickoff Party
John R. Zehner, *Chairman*
Richard Hazen, Barclay G. Johnson
John P. Riley

Women's Entertainment
Elmer K. Timby, *Chairman*
Mrs. Jewell M. Garrelts
Thomas J. Fratar
Gardner M. Reynolds

Women's Committee
Mrs. Jewell M. Garrelts, *Chairman*
Mrs. John R. Zehner, *Vice Chairman*
Mrs. Raymond L. Brandes, *Past Chairman*
Mrs. Algert D. Alexis
Mrs. Carl Arenander
Mrs. Walter D. Binger
Mrs. William N. Carey
Mrs. Robert H. Dodds
Mrs. Arthur J. Fox
Mrs. Thomas J. Fratar
Mrs. Richard Hazen
Mrs. Barclay G. Johnson
Mrs. Enoch R. Needles
Mrs. William S. LaLonde, Jr.
Mrs. Robert K. Lockwood
Mrs. Edward J. McGrew, Jr.
Mrs. Charles B. Molineaux
Mrs. John F. Malloy
Mrs. Malcolm Pirnie, Jr.
Mrs. Carlton S. Proctor
Mrs. Arthur E. Poole
Mrs. Don P. Reynolds
Mrs. Gardner M. Reynolds
Mrs. Richard H. Tatlow, III
Mrs. Elmer K. Timby
Mrs. Charles E. Trout
Mrs. Emil A. Verpillot
Mrs. Edward Wesp, Jr.
Mrs. Clinton W. Wixom

Membership Luncheon
Richard H. Tatlow, III, *Chairman*
Clinton W. Wixom
Edward J. McGrew, Jr.

Publicity
Robert H. Dodds, *Chairman*
John R. Zehner Richard Hazen

Smoker
Richard Hazen, *Chairman*
Algert D. Alexis Emil A. Verpillot

Student Activities
Robert H. Dodds, *Chairman*
Raymond L. Brandes

Convention Coordinator
Don P. Reynolds

Reinforced concrete columns quickly designed by chart

R. L. SANKS, A. M. ASCE

Assistant Professor
University of Utah
Salt Lake City, Utah

One of the handiest and most informative charts for reinforced concrete column design is that illustrated by the accompanying Fig. 1. It can be plotted rapidly because all the lines are straight and the "column size" lines are parallel. A glance suffices to indicate all the various sizes of columns, percentages of steel reinforcement, and size and number of steel reinforcing bars. For office use, the chart is best plotted on graph paper ruled ten lines to the inch. The chart, as well as this article, is based on "Building Code Requirements for Reinforced Concrete" (ACI 318-51).

To illustrate the use of the chart, Fig. 1, assume that it is required to design a column for an axial load of 400 kips. Following the horizontal line at 400 kips to the right, we see that the following columns are satisfactory:

Size	Steel Area, %	Size and No. of Bars
24 × 24	1.3	6 #10φs, 8 #9φs or 12 #7φs
22 × 22	2.3	8 #11φs, 10 #10φs or 12 #9φs
20 × 20	3.7	10 #11φs or 12 #10φs

Most building columns must be designed for moment as well as for axial load. The ACI Code permits a very rapid approximate method which is sufficiently accurate for design. The following problem illustrates a typical interior column design:

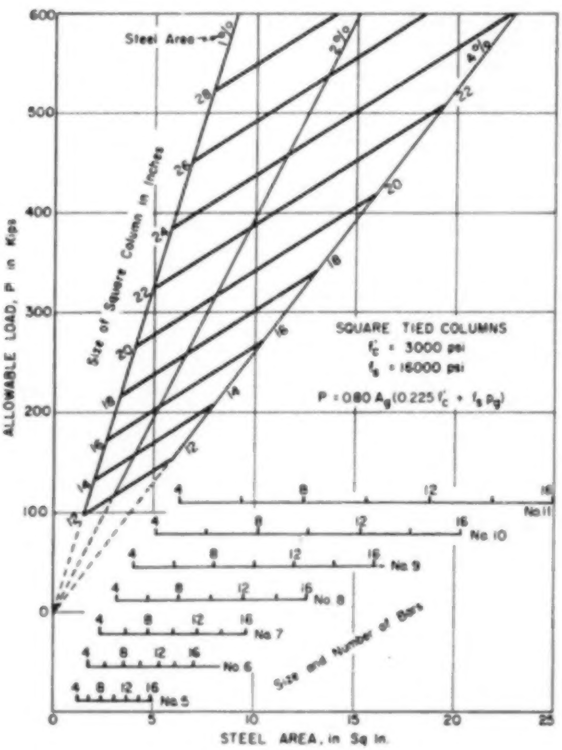


FIG. 1. Chart simplifies design of square tied columns of reinforced concrete.

Assumptions. Floor bays, 20 ft × 20 ft; story height, 16 ft (14 ft, clear column length); live floor load, 0.200 kips per sq ft; equivalent earthquake force, 0.08; and axial load, 318 kips.

Solution. Find total column moments by moment distribution or approximately by the following method:

$$M_{\text{floor load}} = \frac{WL}{40} \qquad (1)$$

$$= \frac{(20 \times 20 \times 0.200)20}{40}$$

$$= 40 \text{ kip-ft}$$

in which

M = moment
W = live load per bay
L = length of bay
40 = coefficient determined by moment distribution for typical columns

$$M_{\text{earthquake}} = N\frac{h}{2}E \qquad (2)$$

$$= 318\,\frac{14}{2}\,0.08 = 178 \text{ kip-ft.}$$

in which

N = column load
h = clear story height
E = equivalent earthquake-force coefficient

$$e = \frac{M_{\text{floor}} + M_{\text{earthquake}}}{N} \qquad (3)$$

$$= \frac{178 + 40}{318} = 0.685 \text{ ft}$$

$$= 8.2 \text{ in.}$$

$$P = N\left(1 + \frac{CDe}{t}\right) \qquad (4)$$

in which

P = allowable load
e = eccentricity, in inches
C = coefficient, from Fig. 2
D = 6 for tied columns (ACI Code permits D to be taken as 5, but this is often unsafe.)
t = depth of column

For the first trial solution, assume 2 percent steel and $t = 22$.

$$P_{design} = 318\left(1 + \frac{0.5 \times 6 \times 8.2}{22}\right)0.75 = 506$$

(Multiplying the design force by $^3/_4$ (or 0.75) is equivalent to using a $33^1/_3$ percent increase in allowable working stresses; the increase is permissible when designing for wind or earthquake in conjunction with other forces.)

For the second trial assume 1.6 percent steel and $t = 26$.

$$P_{design} = 318\left(1 + \frac{0.48 \times 6 \times 8.2}{26}\right)0.75 = 456$$

Use a 26-in. column with eight No. 10 bars.

It is usually wise to design columns for multi-story buildings for 20 to 40 kips more than the design load. The extra concrete and steel cost little, and the added strength permits the owner to add curtain walls or other loads that would overstress a smaller column.

The writer wishes to express appreciation to R. L. Sloane, M. ASCE, who assisted in the preparation of the accompanying figures.

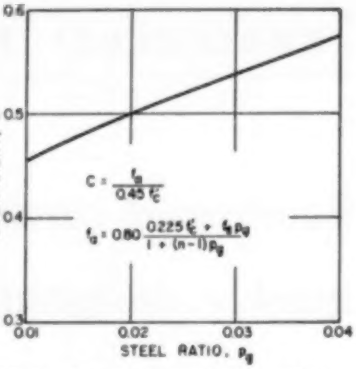


FIG. 2. Curve gives value of coefficient *C* in Eq. 4.

THE READERS WRITE

Fines in sand cause waste disposal problem

TO THE EDITOR: The article, "Six-Million-Dollar Plant Recovers Fine Coal from the Susquehanna River," by Messrs. Levin and Smith, in the July issue, is a competent account of one of the most interesting engineering projects with which I have been associated in recent years. In this discussion I should like to supplement the authors' brief review of the waste disposal problem.

About half a million cubic yards of wastes are to be deposited annually in a valley, and held in place by a dam that will grow eventually to a height of about 275 ft. The first tentative plans were to follow the usual procedure for the deposition of mine tailings, assuming that the tailings themselves would develop sufficient strength to stabilize the downstream slope of the dam. The fact is that many dams composed of mine tailings have failed because they are inherently very unstable. Most such failures have not resulted in serious losses, but there have been disasters, the worst in Japan, where the failure of such a dam caused the loss of hundreds of lives. These comments apply also to many fine-grained industrial waste products, such as those from the soda ash process, which have caused disastrous dike failures in several countries.

The engineers of the Pennsylvania Water & Power Company were not satisfied with the customary procedures for building such dikes in mining operations, and arranged to have these waste materials thoroughly investigated from the standpoint of soil mechanics. Based on these investigations the dam was designed, and construction procedures were developed.

The refuse consists of two principal types of materials: (1) the bulk is in the form of the so-called slimes, of which about 50 percent are silt sizes, that is, passing the No. 200 sieve, and the remainder is fine sand; and (2) what is simply called the sand, a combination of the table refuse and flotation tailings consisting of about 90 percent medium and fine sand sizes, and about 10 percent passing the No. 200 sieve. It is this silty sand which is being used for the construction of the dam.

Strength and compaction tests on this sand showed that it would be well suited for the construction of a stable rolled-earth dam section. The cross section would be essentially equal to the downstream half portion of a regular earth dam, with the added provision that it be underlain by a pervious drainage blanket.

The sand is deposited in settling troughs along the crest of the dam, then transported by bulldozers to the particular part being built up at the time. There, the sand is spread in an 8-in. layer and compacted with a crawler-type tractor. Some difficulty was experienced initially when it was found that the sand did not drain readily, making its compaction excessively time consuming.

Field techniques were developed, however, which reduce the moisture content of the sand prior to placement and compaction, eliminating most of this difficulty.

While the approach to the waste disposal problem on this project was unique, it is a good example of the general approach that should be followed when dealing with the disposal of large masses of fine-grained industrial or mining wastes.

A. CASAGRANDE, M. ASCE
Prof., Soil Mechanics and Foundation Engineering
Harvard University

Cambridge, Mass.

Labor union pressure should shock us into action

TO THE EDITOR: In answer to the article in the July issue entitled, "Forced to Join a Union, It Can Happen to You," by L. Stewart McCoy, I would like to bring up a few points.

It was my good fortune to be able to join a union while attending the University, 1935 to 1941. Non-union wages were \$0.40 per hour, for a 10-hour day; union wages, \$0.625 per hour for an 8-hour day, with dues of \$1.00 per month. I owe a great deal to this union since the union work helped me to finish school. Recently my boy joined a local of this same union. His hourly wage is \$2.05, which is alarmingly close to what many civil engineers are now earning in municipal employ.

This area supports 11 registered civil engineers, only 3 of whom support the ASCE by membership.

The labor unions see us as another fairly poorly paid and indifferently organized group of working men, which two deficiencies they are willing and able to move in and correct. This labor union pressure looks to me like one of the best things that could happen to the engineering profession. It should shock us into action. As something to do personally and right now I suggest the following:

1. Send off 15 cents to the Engineers Council for Professional Development, 29 West 39th Street, New York 18, N. Y., and ask them to send you a copy of *The Second Mile* by W. E. Wickenden, read it, and give it to a fellow engineer to read.
2. Get a 10-cent memo book and note in it what you do for the profession for at least the 15 minutes a day you owe to it.
3. Take part of the 15 minutes and start looking into how the other professions

operate—law, medicine, and the clergy—and reflect and study how they got that way.

We can certainly turn up a solution if we all put our heads together and devote some time to it.

Francis G. Yates, A.M. ASCE
Past Member, International Hod Carriers, Building, and Common Laborers' Union of America, Local 300
Santa Rosa, Calif.

Continuity—surely an asset

To the Editor: The article by Mr. Hoadley, "Continuity—Asset or Liability?," in the July 1954 issue, was especially informative in the matter of the design of a frame with yielding joints. However, the writer must take some issue with the author's basic contention that simple span designs for the given frame are more economical in material weight than a design utilizing full joint continuity.

By using somewhat more common rigid-frame beam-to-column depths the writer arrived at a design which consists of a 16 WF 40 beam and 12 WF 40 columns. The basic frame dimensions and loads were identical with those used by the author. Analysis was by customary elastic methods and the design was based on a close observance of the 1946 AISC specification.

Beam weight	40 × 37 =	1,480 lb
Column weight	2 × 40 × 15.67 =	1,250 lb
	Total	2,730 lb

Note that this weight is 96.5 percent of the very lightest design given by the author, and it is only 82 percent of the author's rigid-frame design. There is evidently much to be gained by using relatively stiff columns for frames of this type. Architectural layouts should be made on this basis wherever possible.

Also, just a mention should be made of the evident preference which a rigid-frame enjoys in the matter of providing a structural element that will resist lateral wind or seismic loads.

Norman B. Jones, J.M. ASCE
Structural Engineer
Whittier, Calif.

Value of sloping-sill sand screens reaffirmed

To the Editor: An interesting discussion of my article in the March issue entitled, "Sloping-Sill Sand Screens Exclude Silt from Egyptian Irrigation Canals," was presented by Harold Tults in the June issue (p. 69). I must agree with Mr. Tults that there are other factors besides the angle of twist which may influence the hydraulic flow and the silt-carrying capacity of a canal intake. However, a deeper insight into the theory of this problem, as well as practical considerations, concur in tending to reduce the number of factors requiring to be included in the structural solution of this problem. Just in the same way, a structural engineer designs a plate girder depending on its section modulus and shear resistance, and disregards the stress concentrations at rivet holes, which may be as great as three times the specified limit, not because he refuses to believe in their existence, but simply because they are not needed in current practice, for obtaining a fully safe and reasonably economical structure. Mr. Tults has introduced no conclusive evidence that new factors should be included in the practical solution presented in my article—a solution that has resulted in material savings in the annual expenditure for canal cleaning, by excluding silt from canals.

It is true, also, that Schocklitsch and other early laboratory investigators disregarded the effect of the angle of twist or misunderstood its effect. But the reason for publishing my article was to draw the attention of American engineers to the irreconcilable difference that exists between the two angle-of-twist doctrines—that in favor and that against—that in favor being advocated by some practicing irrigation engineers, that against by laboratory men.

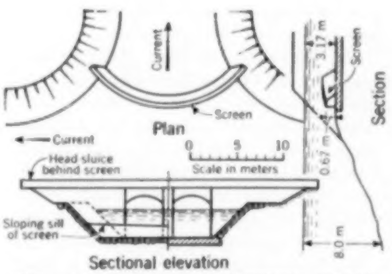
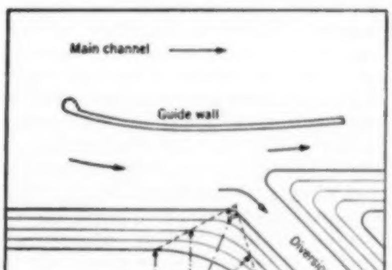


FIG. 4. (From Dr. Leliavsky's article) Illustrative design of sloping sand screen is shown in plan and cross sections.



Mr. Tults' FIG. 1, showing arrangement of his curved guide wall and upstream embankment of intake, with contour lines indicating reduction of embankment radius toward bottom.

Let's compare the respective merits of the sloping sand-screen shown in my article (Fig. 4, on page 70 of the March issue), with those of Mr. Tults's proposed arrangement (Fig. 1 of his discussion on page 70 of the June issue). See the two figures reproduced here.

Compare these two from various aspects, as follows:

Structural. The sand-screen is, in this case, a 2-ft-high wall built on a light concrete foundation in the canal itself. Mr. Tults's guide wall under the same conditions is a 25-ft-high structure in the channel of the river, requiring a strong foundation protected by sheetpiling to prevent under-scour. The respective lengths are about 50 ft and 250 ft.

Construction. The sand-screen can be built concurrently with the main headworks and should not call for much additional unwatering. Mr. Tults' alternative scheme requires a special cofferdam and unwatering installation, which might cost more than all the other works taken together.

River regulation. Maintenance engineers on the Nile barrages spend yearly thousands of pounds on river training, in order to distribute the discharge uniformly through the hundred or so sluice gates of the dams. A structure such as that suggested by Mr. Tults, built in front of a barrage, would play havoc with the effect of the training works.

Navigation. In Mr. Tults' arrangement, craft plying the river would be thrown by the current against the guide wall, and the owner of the irrigation works would be faced with numberless law suits.

In every phase of engineering the efforts of scientific men engaged in laboratory experimentation must be coordinated with those of executive engineers dealing at first hand with problems in the field.

Dr. Serge Leliavsky, M.ASCE
Civil and Hydraulic Engineer
Maadi, Egypt

Credit for stack erection

To the Editor: In the article in the August issue, "OVEC Steam Plants Furnish 2,200,000 kw for AEC Gaseous Diffusion Plant, Portsmouth, Ohio," by Philip Sporn and the writer, a caption on page 45 incorrectly gives credit to the Custodis Construction Co. of New York and Chicago as the designers and builders of the stacks at both the Kyger Creek and Clifty Creek steam plants. While the stacks at the Clifty Creek plant are the work of the Custodis Construction Co., those at Kyger Creek are being erected by the M.W. Kellogg Co. of New York.

H. A. Kammer, A.M. ASCE
Vice President, Ohio Valley Electric Corp.
New York, N.Y.

SOCIETY NEWS

Three Honorary Members to Be Inducted During Annual Convention Program

All three of the new Honorary Members of ASCE are consulting engineers, and two of them are specialists in bridge design and construction. Those receiving the Society's recognition of their contributions to the profession are Robert J. Cummins, of Houston, Tex.; Shortridge Hardesty, of New York, N.Y.; and Edward P. Lupfer, of Buffalo, N.Y. Presentation of the honorary memberships will be one of the features of the Wednesday (October 20) luncheon program during the forthcoming Annual Convention in New York.

Highlights in the careers of the three new Honorary Members follow.

Robert J. Cummins

Any view of the Houston, Tex., skyline shows an amazing number of notable buildings that owe their structural design to Robert J. Cummins, who has had an engineering practice in Houston since 1911. Projects he has handled include special structural groups such as the University of Houston and the U. S. Veterans' Hospital, many industrial plants in the area, and the numerous marine installations along the Houston Ship Channel. Other prominent examples of his work may be seen in such Texas cities as Corpus Christi and Brownsville, where the initial development of now thriving deep-water ports was under his direction.

R. J. Cummins, Hon. M.

The famous San Jacinto Monument near Houston is another striking example of his versatility.

Mr. Cummins was born and educated in Ireland, receiving engineering and art degrees from Queens College at Galway, which was at that time affiliated with the Royal University of Ireland. Coming to the United States as a young man in 1901, he went first to Grand Rapids, Mich., and then Detroit, where he helped organize Adams & Cummins, a consulting firm specializing in structural design. In 1911 he decided to broaden the field of the firm's work and selected Houston as his headquarters. After a few years the firm was dissolved, and since then his work has been solely under his own name.

Mr. Cummins has filled many assignments of national importance. He was special engineer adviser to the Reconstruction Finance Corporation on the Metropolitan Water District of Southern California and on the San Francisco-Oakland Bay Bridge, and technical adviser to the International Boundary Commission, United States and Mexico.

An initial member of the Houston Port Commission, Mr. Cummins played an important part in the development of the port. He was a member of the commission for twenty-five years and vice-chairman for fifteen. He has been director of the Houston Chamber of Commerce, and is now active on its Flood Control Committee. His civic work also includes membership on the postwar planning commissions of Houston and Bellaire and continuous service since 1933 on the Advisory Board of the Houston Branch of the Reconstruction Finance Corporation. He has also been drainage commissioner for the Houston area. His long-time aid to engineering students in Texas colleges as guest speaker and career consultant has won for him honorary membership in Tau Beta Pi at Texas A & M and in Chi Epsilon at the University of Texas.

A member of the Society since 1920, Mr. Cummins has been chairman of the Committee on Juniors and the Committee on Employment Conditions. He has been president and director of the Texas Section and president of its Houston Branch. Much of the success of the Society's Houston Convention, held in February 1951, is attributed to his arduous work as chairman of the local General Committee.

Shortridge Hardesty

Shortridge Hardesty, member of the New York consulting firm of Hardesty & Hanover, is widely recognized as one of the country's leading designers of bridges, both fixed and movable. Among his important projects are the Port of New York Authority's Goethals and Outerbridge cantilever bridges across the Arthur Kill; the Cooper River cantilever bridge at Charleston, S.C.; the Mississippi River cantilever bridge at Cairo, Ill.; the Anthony Wayne suspension bridge at Toledo, Ohio; the Hudson River lift bridges at Albany and Troy, N.Y.; the North and South Grand Island bridges over the Niagara River; eleven vertical lift railroad bridges over waters in the metropolitan area; five bascule bridges for various New York City authorities; the Rainbow Arch Bridge across the Niagara River with E. P. Lupfer (both firms having equal responsibility); the Marine Parkway Bridge over Rockaway inlet (the longest vertical-lift highway span); the Passaic and Hackensack River vertical-lift bridges for the New Jersey State Highway Department; and the Captree Bridge for the Jones Beach State Parkway Authority. Current projects include the New York Central Railroad's Harlem River lift bridge and two bridges over the Cuyahoga River at Cleveland,

Shortridge Hardesty, Hon. M.

Ohio—a lift bridge for the Nickel Plate Railroad and a bascule span for the Baltimore & Ohio Railroad.

Born at Weston, Mo., Mr. Hardesty graduated from Drake University at Des Moines, Iowa, in 1905 with the bachelor of arts degree, and from Rensselaer Polytechnic Institute in 1908 with the civil engineering degree. He entered the office of Waddell & Harrington in Kansas City, Mo., in 1908, becoming designing engineer for the successor firm of Waddell & Son in 1916. Since 1920 he has been with the firm in New York—until 1926 as associate engineer with the late Dr. J. A. L. Waddell, from 1927 to 1938 in partnership with Dr. Waddell under the firm name of Waddell & Hardesty, from 1938 to 1945 in practice under the same name, and since 1945 under the name of Hardesty & Hanover, with C. D. Hanover, Jr., as partner.

In association with others, Mr. Hardesty's firm assisted in preparing planning studies for the cities of Portland, Oreg., and New Orleans, La.; designed the Cross-Bronx and Van Wyck Expressways; worked on the design of the Schuylkill Expressway and Pennsylvania Boulevard in Philadelphia; and is at present engaged in the design of the Niagara Section of the New York State Thruway and on the design and supervision of construction of sections of the Ohio Turnpike and the Indiana Toll Road.

Mr. Hardesty has made extensive studies relative to the design of structural, mechanical, and electrical features of movable and other types of bridges, fatigue, and the application of lightweight floors, alloy steels, and structural aluminum to bridge design and construction. He has been a member of the Committee on Iron and Steel Structures of the American Railway Engineering Association for years, and of the executive committee of the Advisory Board on the Investigation of Suspension Bridges, which has been studying vibrations and stiffness. He is also chairman of the Column Research Council, which was organized under Engineering Foundation to study the design of meta compression members.

Mr. Hardesty has received three honorary degrees—doctor of laws from Drake University in 1928, doctor of engineering from Union College in 1949, and doctor of engineering from Rensselaer Polytechnic Institute in 1951.

A Junior Member of ASCE since 1908, an Associate Member since 1916, and a Member since 1923, Mr. Hardesty served as Director from 1946 to 1949, as chairman of the executive committee of the Structural Division in 1941, and as director of the Metropolitan Section from 1942 to 1945. He is holder of the Society's Norman Medal and the Thomas Fitch Rowland Prize for papers in TRANSACTIONS.

Edward P. Lupfer

Many of the important engineering works in New York State and its second city, Buffalo, are a monument to the engineering artistry and skill of Edward P. Lupfer, of Buffalo. Though Mr. Lupfer's specialty is bridge design and construction, his long service to his home city and to various engineering, professional, and civic groups has involved many other types of engineering work.

Born near Blain, Pa., Mr. Lupfer was educated in the Kansas public schools and at the University of Kansas (class of 1896). In 1944 he received a "citation" from the university "for outstanding achievement in civil engineering work"—the equivalent of an honorary degree from the university, which is prohibited by state law from granting honorary degrees to alumni. In 1953 he was honored by his alma mater by election to the alumni rolls in Lambda Chapter of Sigma Tau, honorary engineering fraternity. After leaving the university he was engaged in railroad work in the West, and from 1903 to 1907 was construction engineer for the Buffalo & Susquehanna Railroad on the building of a ninety-mile line across the western part of New York.

Since 1907 Mr. Lupfer has been in private practice in Buffalo. Projects handled by his firm include the building of North End Breakwater Lighthouse in Buffalo, one of the largest in the Great Lakes; design and supervision of construction of the Michigan Avenue direct-lift bridge across the Buffalo River (the first of its kind in western New York); design and supervision of building the Peace Bridge across the Niagara River at Buffalo; and design and supervision of construction, with Waddell & Hardesty as associates, of the new Rainbow Arch Bridge across the Niagara River at the Falls. On the latter project each firm had equal power and responsibility in the performance of the design and supervision of construction, with Waddell & Hardesty making the design and the Lupfer Corp. supervising the construction. In 1949, the Edward P. Lupfer Corp., of which he is president, was given a contract by the State of New York for the preparation of plans, specifications, and estimates for a $13,000,000 high-level bridge across Main Street in Buffalo. More recently he has

E. P. Lupfer, Hon. M.

been consultant to the state on many Thruway plans affecting the city and designing engineer on parts of the Thruway in the city.

During 1935, 1938, and 1944 Mr. Lupfer was consulting engineer to the Army Corps of Engineers on studies of the Cuyahoga River and other work in the vicinity of Cleveland, Ohio, totaling some $55,000,000. From 1936 to 1941 he was directing engineer for the Buffalo Sewer Authority in charge of design and construction of a $15,000,000 sewer system for the city. During the war he was regional consultant director of Area No. 5 of the Defense Plant Corporation, taking in New York State from Utica west. To this work Mr. Lupfer gave his entire time, serving as consultant without salary on projects amounting to almost a billion dollars. He received a government citation for his services in 1943.

Long a member of the Society, Mr. Lupfer was president of the Buffalo Section in 1928. In April 1930 he was appointed ASCE Director for District 3 to fill the vacancy caused by the death of George H. Norton, and in 1931 was elected Director of the District for a three-year term of his own. From 1936 to 1938 he was Vice-President for Zone I. As senior Vice-President, he served as Acting President during the illness of President Louis C. Hill from May 1937 to the following January. His other service on the Board of Direction included a year on the Executive Committee and four years on the Committee on Publications.

Mr. Lupfer is a former director of the Buffalo Chamber of Commerce, and a director and founder of the Buffalo Municipal Research Bureau. Beginning in 1941, he served on the National Panel of Arbitrators of the American Arbitration Association for several years.

ASCE Prizes to Be Awarded at Convention

Winners of ASCE prizes and awards for papers appearing in Volume 118 and *Volume CT* of TRANSACTIONS (1953) were announced by the Board of Direction at its Atlantic City meeting in June. The Construction Engineering Prize, unlike the others, is given for an article in CIVIL ENGINEERING. Presentation of the awards will be a feature of the Wednesday morning business meeting (October 20) during the Society's Annual Convention in New York. The various awards are described in the Official Register for 1954, beginning on page 111. Highlights in the careers of those receiving prizes and medals follow.

Robert H. Sherlock

Robert H. Sherlock, M. ASCE, professor of civil engineering at the University of Michigan and this year's winner of the Norman Medal for a paper on "Variation of Wind Velocity and Gusts with Height," has combined an active teaching career with outside consultation on design, investigations, appraisals, and reports.

ROBERT H. SHERLOCK
Norman Medal

He has made many researches for industries and agencies, including the National Electric Light Association, the Commonwealth Edison Co., of Chicago, the U.S. Navy Department, and the Stran-Steel Division of the Great Lakes Steel Corp. These studies have embraced wind gusts, the flow phenomena of smoke stacks, atmospheric turbulence, and wind velocities for the design of low buildings.

A civil engineering graduate of Purdue University, class of 1910, Professor Sherlock went to the University of Michigan in 1923 as assistant professor of civil engineering. He was associate professor from 1926 to 1933, and has been a full professor since 1933. For most of the period between 1910 and 1923 he was with the American Bridge Co., at Toledo, Ohio, on structural detailing, estimating, supervision of field work on bridge and dock repairs, etc. Professor Sherlock is the author of several reports and of many papers that have been published in the technical press here and abroad.

Bruce G. Johnston and F. K. Chang

The paper, "Torsion of Plate Girders," for which Bruce G. Johnston and F. K. Chang, Members ASCE, are awarded the J. James R. Croes Medal, is a sequel to "Structural Beams in Torsion" for which, with Inge Lyse, Professor Johnston received the J. James R. Croes Medal in 1937 also. Since 1950 Professor Johnston has been at the University of Michigan, as professor of structural engineering. In addition to his teaching work he has conducted research projects and acted as a consultant—principally in the field of behavior of steel structural members and frames, with emphasis on plastic strength and behavior under shock loading. Before going to Ann Arbor, he was director of the Fritz Engineering Laboratory at Lehigh University, having served on the faculty of that institution since 1938, and as a research fellow from 1932 to 1934. Except for three years during the war, he was in charge of structural research and materials testing at the laboratory. From 1942 to 1945 he was on leave—first with the Bureau of Yards and Docks, U.S. Navy, then with the Johns Hopkins Laboratory of Applied Physics, as project supervisor of structural design. Professor Johnston holds B.S., M.S., and Ph.D. degrees—from the University of Illinois, Lehigh University, and Columbia University, respectively—and is author or co-author of numerous technical papers, principally on the behavior of steel structures.

Fu-Kuei Chang, co-winner of the J. James R. Croes Medal, was born in the Shansi Province of China and graduated with a B.S. degree in civil engineering in 1942 from the Tang-Shan Engineering College, Chiao Tung University. Coming to the United States in 1945 for further study, he was with the Pennsylvania State Highway Department for a year, and then attended Lehigh University. While at Lehigh, he was also employed as research assistant in the Fritz Engineering Laboratory and did research on photoelasticity, numerical analysis, and torsion. He is the co-designer of the 2,000,000 in.-lb torsion-testing machine built at the laboratory and the co-author of several published papers. In 1947, he received the master of science degree from Lehigh University, and in 1950 the degree of doctor of philosophy. From 1950 to 1953, he worked with the Bridge unit of the Pennsylvania State Highway Department as bridge designer on various types of highway bridges and structures. With Ammann and Whitney since March 1953, he has participated in the design of the new Delaware River Bridge at Philadelphia, its approach spans, and other interesting projects.

F. K. CHANG

BRUCE G. JOHNSTON

Winners of J. James R. Croes Medal

A. WARREN SIMONDS
Thomas Fitch Rowland Prize

T. A. MIDDLEBROOKS
James Laurie Prize

A. Warren Simonds

A. Warren Simonds, M. ASCE, winner of the Thomas Fitch Rowland Prize for a paper on "Final Foundation Treatment at Hoover Dam," is a structural engineer for the U.S. Bureau of Reclamation. He received both a bachelor of science and the professional degree of civil engineer from the University of Texas in 1921, and a master of science degree from the University of Colorado in 1933.

Long on the staff of the Bureau of Reclamation, Mr. Simonds' work has included research, design, and construction for the organization. He took part in the preliminary design of Hoover Dam and contributed to the development of the "trial load" method of analysis of arch dams, and was in charge of a program of research involving tests of model dams for strain, stress, and deflection. He was also in charge of the grouting programs during the construction of Grand Coulee, Marshall Ford, Shasta, Friant, and a number of other Bureau of Reclamation dams.

Mr. Simonds has been a consultant to several other agencies on problems of foundation treatment where pressure grouting has been involved. These include the Panama Canal Commission, the U.S. Navy Department, the New Zealand Ministry of Works, the City of Sydney, Australia, and the Water Works Bureau of Tokyo, Japan. His professional activities include membership on the U.S. Committee of the International Commission on Large Dams of the World Power Conference.

Thomas A. Middlebrooks

This year the James Laurie Prize is awarded posthumously to the late T. A. Middlebrooks, A.M. ASCE, noted authority on soil mechanics and a second-time winner of the James Laurie Prize. The current award is made for his paper on "Earth-Dam Practice in the United States." Born at Yatesville, Ga., Mr. Middlebrooks got his bachelor degree in civil engineering at the Georgia School of Technology in 1928, and did graduate work at the Massachusetts Institute of Technology in 1930. He spent his career in the Corps of Engineers—from 1928 to 1933 on levee design and construction; from 1933 to 1937 as chief of the soil mechanics and foundation branch at Fort Peck Dam; and from 1937 to his death on February 3, 1954, as chief of the soils branch in the Office of the Army Chief of Engineers, Civil Works, Washington, D.C.

In addition, Mr. Middlebrooks had served as consultant on many projects in the United States, to the French government on a dam project in the Alps, and on a proposed dam site in Africa, and had done special studies on the Panama Canal. He was author of many papers on soil mechanics, and served as chairman of the United States delegation to the Second International Soil Mechanics Conference in Rotterdam in 1948.

Maj. Gen. Claude H. Chorpening

Claude H. Chorpening, M. ASCE, Major General, Corps of Engineers, winner of the Arthur M. Wellington Prize for a paper on "Waterway Growth in the United States," has spent his career in the Corps of Engineers. Since April he has been with the Army Forces in the Far East in the Office of the Assistant Chief of Staff, G4. Born at Waterloo, Iowa, he is a West Point graduate, class of 1918, and has studied at the Engineer School at Camp Humphreys, Va., and at the Command and General Staff School at Fort Leavenworth. In his early career he was executive of the New Orleans Engineer District, and secretary and instructor at the Engineer School at Fort Belvoir. He served in the Fort Peck District for over five years, in charge of various important phases of the construction of Fort Peck Dam, and in the last two years of his assignment was in direct charge of all construction on the dam.

More recent assignments have been as chief of the Development Branch, Supply Division, in the Office of the Chief of Engineers, and executive officer of the Supply Division; district engineer of the Tulsa (Okla.) Engineer District; and three years as Assistant Chief of Engineers for Civil Works. For his wartime service in the European Theater from 1943 to 1945, General Chorpening was awarded the Legion of Merit and Bronze Star Medal, and the Order of British Empire from the British Government.

Vaughn E. Hansen

The Collingwood Prize for Juniors goes to Vaughn E. Hansen, J. M. ASCE, research associate professor of irrigation engineering at Utah State Agricultural College, for a paper entitled "Unconfined Ground-Water Flow to Multiple Wells." A graduate of Utah State, Mr. Hansen received the bachelor's degree in civil engineering in 1943 and the master's degree in 1947. He did early work at the Utah Experiment Station for the U.S. Department of Agriculture and the Soil Conservation Service. A member of the U.S. Naval Reserve, Mr. Hansen directed the Bureau of Ordinance special devices section in the Fourth Naval District during the war, with the ranks of ensign and lieutenant (j.g.). Later he did research at the Iowa Institute of Hydraulic Research, and conducted a field study of sugar production as affected by soil moisture and fertilizer for the Bureau of Plant Industry and the Utah Experiment Station.

R. S. Archibald and H. A. Thomas, Jr.

Co-winners of the Rudolph Hering Medal are Ralph S. Archibald, J.M. ASCE, and Harold A. Thomas, Jr., whose subject was "Longitudinal Mixing Measured by Radioactive Tracers." Mr

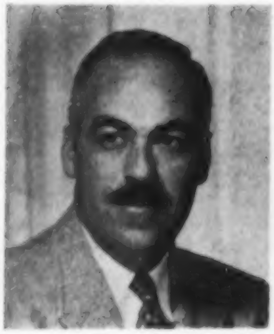
C. H. CHORPENING
Arthur M. Wellington Prize

VAUGHN E. HANSEN
Collingwood Prize for Juniors

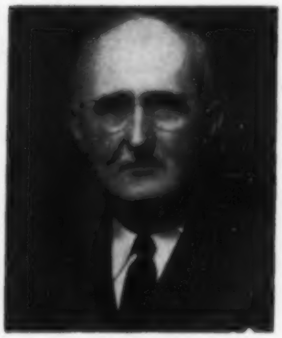
RALPH S. ARCHIBALD

HAROLD A. THOMAS, JR.

Winners of Rudolph Hering Medal



JEROME M. RAPHAEL
Leon S. Moisseiff Award



JULIAN HINDS
James W. Rickey Medal

W. DOUGLAS BAINES
J. C. Stevens Award

S. D. STURGIS, JR.
Construction Engineering Prize

Archibald graduated from Tufts College in 1945, with a B.S. degree in civil engineering, summa cum laude, and from Harvard University Graduate School of Engineering in 1947 with the M.S. in sanitary engineering, and in 1949 with the master of engineering degree. At Harvard he was awarded the Clemens Herschel Prize, and the present prize-winning paper was written at Harvard under a fellowship from the Boston Society of Civil Engineers' Freeman Fund. Mr. Archibald was employed by several consulting sanitary engineering firms in Boston prior to taking his present post in 1950 as sales engineer with the Pipe Founders Sales Corp., in Boston.

Harold A. Thomas, Jr., is associate professor of sanitary engineering at Harvard University. Following graduation as a civil engineer from Carnegie Institute of Technology in 1935, he did research in the hydraulic laboratory there and then studied at Harvard, where he received the master of science degree in sanitary engineering in 1937 and the doctor of science degree in 1938. He has been on the Harvard staff since 1939, and has been associate professor of sanitary engineering since 1947. For the past six years, in addition to teaching fluid mechanics and sanitary engineering subjects, Professor Thomas has given courses in mathematical statistics in the Division of Applied Science as a side interest. His principal research has been related to fluid mechanics and hydrological problems having sanitary engineering application, particularly in treatment plant design and stream sanitation. Concerned for the past several years with problems involved in the disposal of radioactive wastes in streams and ground water, Professor Thomas has been director of an AEC-sponsored research project in the field at Harvard since 1950. He is also a consultant to the Sanitary Engineering Center of the U.S. Public Health Service and to the Office of Properties and Installations of the Department of Defense.

Jerome M. Raphael

Writing on "The Development of Stresses in Shasta Dam," Jerome M. Raphael, M. ASCE, associate professor of civil engineering at the University of California, is the winner of the Leon S. Moisseiff Award. Professor Raphael received the bachelor and master of science degrees from Massachusetts Institute of Technology in 1934 and 1935. He was continuously employed by the government from 1935 to 1953. From 1935 to 1938 he was with the Pittsburgh District of the Corps of Engineers on tests of the structural behavior of Tygart Dam, then transferred to the Bureau of Reclamation where he began the studies reported in part in his prize-winning paper. From 1948 to 1953 he was in charge of all Bureau of Reclamation investigations on the actual behavior in service of concrete dams, and served on the panel of engineers which redefined the Bureau's criteria for the design of concrete dams in the light of this research.

In 1953 Professor Raphael joined the faculty of the University of California, where he works in the fields of plain and reinforced concrete. He has headed investigations of the stresses found in Hoover, Grand Coulee, Ross, Canyon Ferry, and Hungry Horse dams, and has advised on structural test programs for major dams in India and Australia.

Julian Hinds

With a paper on "Continuous Development of Dams since 1850," Julian Hinds, M. ASCE, an authority in the field of water supply and former Society Director, wins the James W. Rickey Medal. Mr. Hinds was with the Metropolitan Water District of Southern California from its formation in 1928 until his retirement in 1951 as general manager and chief engineer of the District. During his long tenure with the District Mr. Hinds played a leading role in the project of bringing water from the Colorado River to the coastal area.

Since January 1952 Mr. Hinds has been serving as general manager and chief engineer of the United Water Conservation District of Ventura County, where he is directing the planning and construction of a 100,000-acre-ft storage reservoir, the extension of existing spreading facilities, and the construction of transportation and distribution facilities on the Oxnard Plains. He is also a consultant to the Bechtel Corp. and serves on several consulting boards for the U.S. Engineer Department. His affiliations include membership on the United States Committee of the International Commission on Large Dams and on the Water Resources and Power Task Force of the Hoover Commission.

A civil engineering graduate of the University of Texas, class of 1908, Mr. Hinds had early experience teaching at his alma mater and in railroad work in the West. From 1910 to 1926 he was with the U.S. Bureau of Reclamation on a variety of assignments involved in Western reclamation.

W. Douglas Baines

For the best discussion of the TRANSACTIONS paper, "Application to an Hydraulic Problem," W. Douglas Baines, J.M. ASCE, receives the J. C. Stevens Award. Born in Edmonton, Canada, Dr. Baines graduated with a B.S. degree from the University of Alberta in 1947. He did graduate work in fluid mechanics at the State University of Iowa, receiving an M.S. in 1948 and a Ph.D. in 1950. He then taught at Michigan State College until he joined the staff of the National Research Council of Canada.

For the past three years Dr. Baines has been with the hydraulics section of the Mechanical Engineering Division of the Council. His work has been mainly in the field of open-channel flow and sediment transport. Much of his effort has gone into the design and analysis of hydraulic models, particularly the Fraser

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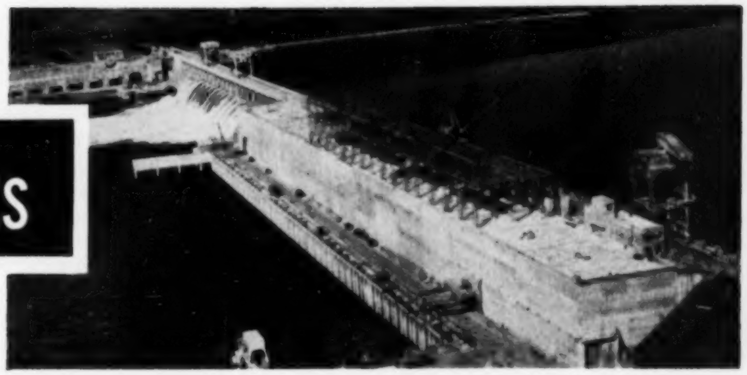
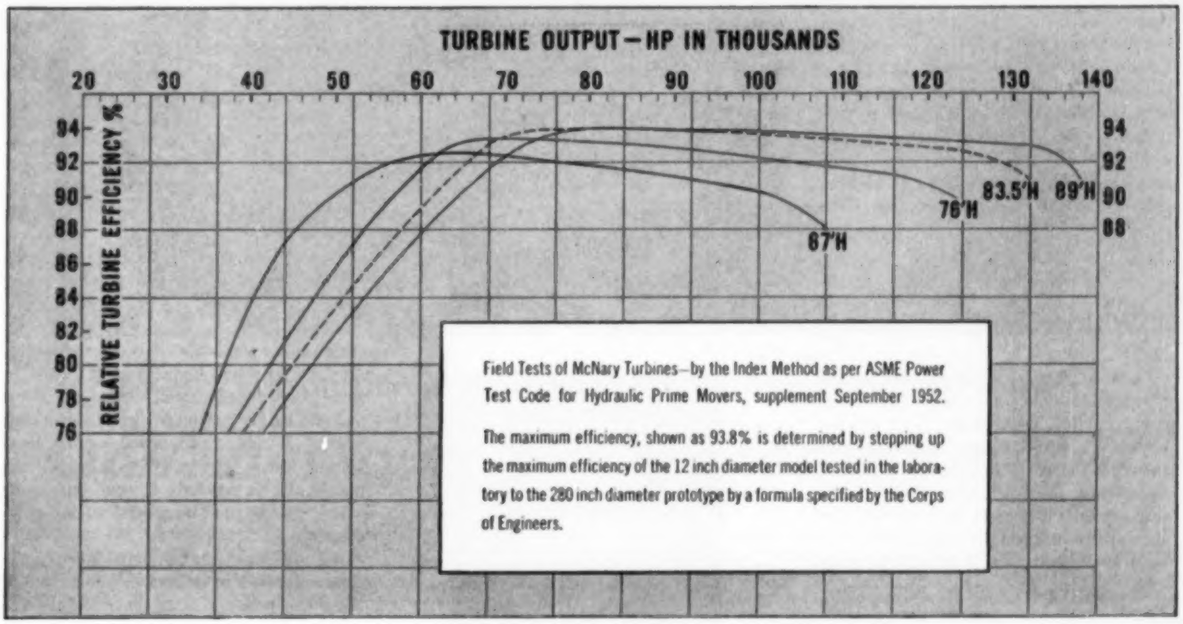
KAPLAN TURBINES





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Field test performance of SMS-Kaplan turbines already in operation at McNary Dam prove them to be the highest powered adjustable blade propeller units in the world.

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River Model. At present he is head of the Council's Hydraulics Laboratory and is concerned with hydraulic studies of the St. Lawrence Seaway.

Maj. Gen. Samuel D. Sturgis, Jr.

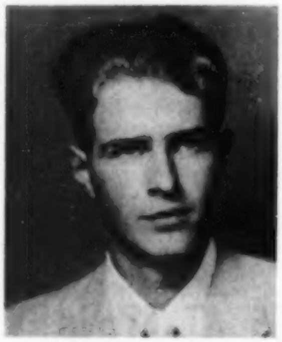
The present Army Chief of Engineers, Maj. Gen. Samuel D. Sturgis, Jr., M. ASCE, is winner of the Construction Engineering Prize—the only award for an article in CIVIL ENGINEERING—for an article in the September 1953 issue on the Thule Air Base. Since his graduation from West Point in 1918, General Sturgis has held every command that it is possible for an Engineer Officer to have, from platoon leader to the commanding general of a Division; from staff officer to commanding general of our Communications Zone in Europe; and from project engineer to Chief of Engineers. His experience in the civil works of the Corps of Engineers includes service as district engineer at Eastport, Me., on the Passamaquoddy Project; district engineer at Huntington, W. Va. on the Ohio River; district engineer at Vicksburg, on the Mississippi River; and division engineer of the Missouri River Division at Omaha, Nebr., where he was in charge of carrying out the Pick-Sloan Plan for the control of floods in the Missouri Basin.

In World War II, General Sturgis served in the Southwest area for three years as chief engineer of the Sixth Army. There he directed the building of airbases, ports, and Army construction in 22 amphibious operations from Australia to Japan. For his services he was awarded the Distinguished Service Medal, the Silver Star, the Legion of Merit, and the Bronze Star Medal. As Chief of Engineers since 1953, General Sturgis commands the world's largest construction agency with a work volume of $4^1/_2$ billion.

J. Waldo Smith Fellowship Goes to Georgia Tech Student

Gunnar Sigurdsson, a native of Iceland, who graduated last June from the Georgia Institute of Technology with highest honors in civil engineering, has been awarded the J. Waldo Smith Hydraulic Fellowship. The ASCE-sponsored fellowship provides a stipend of $1,000 for graduate study in hydraulic engineering, plus $400 for the purchase of specialized equipment needed to conduct the research project.

A graduate of the College of Reykjavik in 1952, Mr. Sigurdsson came to the United States on a Rotary International Scholarship. He distinguished himself as a scholar at Georgia Tech, and received the Georgia Section's award of Junior Membership in ASCE last June for being the outstanding civil engineering graduate. He will do his graduate work at Georgia Tech under the direction of Prof. Carl E. Kindsvater. His experimental investigation will be on the subject, "Overflow Characteristics of Highway Embankments." After he has finished his studies he plans to go back to Iceland and work on developing the tremendous hydraulic power of its rivers.



Gunnar Sigurdsson

New Daniel W. Mead Prize Contest Open

Student Chapter members beginning a new school year and Junior Members are reminded that a new (1955) Daniel W. Mead contest is open. As announced in the July issue, advertising will be the subject of the essays, with both the student and Junior Member contestants writing on the topic, "What kind of advertising should be considered as derogatory to the engineering profession?" Examples may be used to develop the subject. It should be noted that the closing date has been advanced a month, and that all papers intended for entry in the competition must be in the hands of the Executive Secretary of ASCE by May 1, 1955.

The prizes, which were established and endowed in 1939 by the late Daniel W. Mead, Past-President and Honorary Member of ASCE, consist of a Junior Member award of $50 in cash and a certificate and a student prize of $25 in cash and a certificate.

Competitive Bidders Suspended by Board

Fourteen members alleged to have violated the ASCE Code of Ethics were adjudged to be guilty by the Board of Direction at a special hearing on August 20. One was expelled from the Society; another was suspended for a period of five years; and the other twelve were suspended for one year each.

The Board of Direction met in a special session in New York for the purpose of hearing the defense of members involved in competitive bidding in South Carolina. The fourteen members of the Society were heard by the Board either in person or in writing after investigation of charges that each had violated the Code of Ethics in competing on a price basis for the purpose of securing an engineering engagement from the Highway Department of South Carolina. The bids were opened on October 27, 1953. For details of invitation to bid, bid form, and percentages bid, see the March issue (page 77) and June issue (page 73).

Suspension from the Society results in the name of the suspended member being dropped from the rolls as of the date of suspension, in this case August 20, 1954, and during the period of suspension being denied all rights and privileges of membership in the Society. At the end of the period the suspended member automatically returns to membership in good standing.

As provided for in the By-laws, the Board decided to advise each member of the Society by letter of the names of the members judged to have violated the Code of Ethics in this case, and of the disciplinary action taken. It was further agreed that names would not be used in any statement or writing about the case which would be made available to the general public.

In the Board of Direction's investigation by its Committee on Professional Conduct, of this instance of competitive bidding on a price basis in South Carolina, charges were brought against members who had signed and submitted the official bid form furnished by the State of South Carolina and against the members of the Society whose names are included in the official designation of the respective firms submitting bids.

During the investigation of August 20 it developed that other members of ASCE who are partners or officials of these organizations may have been equally responsible for violations of the Code. The Board of Direction instructed its Committee on Professional Conduct to continue its investigation of the October 1953 South Carolina bidding case to determine the advisibility of preferring charges against such other ASCE members.

New Endeavors of Technical Divisions Revealed at Chicago Conference

Extensive new Division activities, planned and in progress, were reported during a two-day Technical Procedure Conference held in Chicago, August 12 and 13. Noted particularly by the 40 Division and Society officers present were cooperative ventures with other professional groups; expanded contact with Local Sections; Division-sponsored conferences; and better communication of the Divisions with their own membership and with the general public. As expressed by ASCE President D. V. Terrell, the marked expansion of the technical activities of the Society has attracted the attention and participation of an ever-increasing segment of the profession, with about 600 individuals now actively involved in some part of the organization.

The conference, an expansion of the Technical Procedure Committee meetings, was attended by President Terrell, Presidential-Nominee Glidden, Vice-Presidents and Directors concerned with the technical department, and officers of the Divisions and related committees. Presiding, as chairman of the Committee on Division Activities, was Edmund Friedman, Vice-President, Zone II.

The Technical Divisions have responsibility for planning and conducting a wide variety of endeavors, which will generate and distribute new information for the profession, stated President Terrell in his keynote remarks. Research, stimulation of papers and manuals, conduct of sessions for presentation of new information were all listed by President Terrell as areas for increasing attention by the men devoting their time and energies to the Divisions. He assured the group of the continued and unstinting support of the Society for such constructive endeavors. His remarks in this respect were given strong support by a report of the chairman of the Budget Committee, Vice-President Enoch R. Needles.

A great deal of the expanded activity of the Divisions has been made possible through better management of committees reported Ralph A. Fadum, chairman of the Engineering Mechanics Division. His was one of nineteen prepared reports to the conference, each with specific proposals for new programs. The new, or increased, effort needed, reported Dr. Fadum, lies in the greater freedom given operating committees and closer supervision of their operations. Specific patterns were described. All these take willing manpower, he concluded.

Some of this new demand for able manpower can be met by specially qualified Junior Members, said Prof. Jewell M. Garrelts, chairman of the Committee on Junior Members and secretary of the Structural Division. More Junior Members are assuming professional obligations, he reported. He added a proposal for new contacts between Local Sections and Technical Divisions to develop such manpower and, at the same time, uncover the information to the Sections. This, he said, will also bring new facilities to the Sections for exchange of technical information. Both Division committees on Local Section cooperation and Section committees on technical specialty interests are needed, he reported, giving results of progress where such machinery is in operation.

Inter-Society Cooperation Essential

Such cooperation has been extended to include other professional groups, reported Blucher A. Poole, chairman of the Sanitary Engineering Division. Four major organizations are working together in this area, he said. As primary benefits resulting he listed avoidance of duplicate activities in two or more groups, ability to plan for most effective outlets for information or activities and, perhaps most important of all, the substitution of a constructive attitude of cooperation for the competitive spirit that has too often delayed or blocked professional progress.

Committees have been found necessary to administer new Division programs, reported Jorj O. Osterberg, secretary, Soil Mechanics and Foundations Division. Operation of the Committee on Session Programs of his Division was detailed as an example by Dr. Osterberg. Similar committees, dealing with publications and research, were described by John C. Bumstead, secretary, Sanitary Engineering Division, and George H. Hickox, chairman, Hydraulics Division, respectively. Dr. Hickox also had a proposal for encouraging task committees to expedite their work and speed the flow of new information to the waiting profession.

New-Type Meetings

A glowing account of a new-type conference was described by Professor Garrelts, who gave facts collected at the Structural Conference held at Kansas City recently. Similar conferences, apart from regular Society conventions, are planned by the City Planning, Irrigation and Drainage, and Hydraulics Divisions, as reported elsewhere in Civil Engineering with details. More advanced information can be presented and more constructive discussion generated at such specialized meetings, reported Professor Garrelts, with more engineers being able thereby to justify the time and expense of taking part.

This same relationship, with support of the Divisions, might well improve the significance of District or regional conferences, suggested Prof. Raymond F. Dawson, Director, District 15. Professor Dawson proposed that the Divisions offer their services to such regional groups in building significant programs. For any such programs the selection of appropriate and adequate speakers is always a problem, said Carl B. Jansen, chairman, Waterways Division. Mr. Jansen charted ways and means for selecting both speakers and subjects that will be of value to engineers' meetings and at the same time attract attendance.

Enthusiasm greeted the report of Frank A. Marston, chairman of the Publications Committee. New procedures will result in wider distribution of technical information, and more information speeded into print too, he reported. [See item in this issue regarding free distribution of more Proceedings-Separates.]

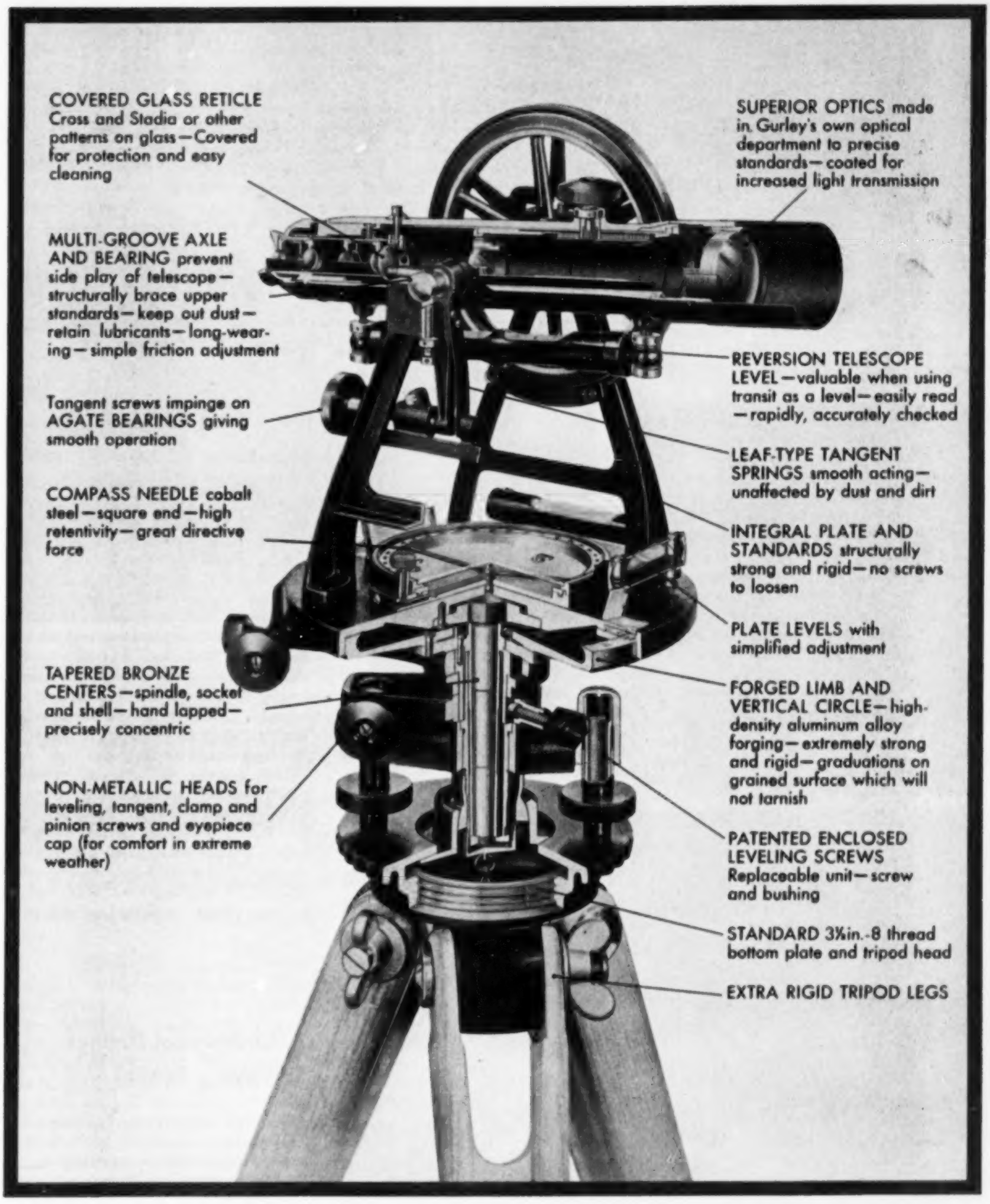
Public Relations to Be Emphasized

Better contact between Divisions and their members is essential, urged Mr. Jansen. In a report prepared by Roger H. Gilman, secretary of his Division, Mr. Jansen told of newsletter contacts and renewed member interest resulting. Contact with the general public is needed also, said Don P. Reynolds, assistant to the Secretary of ASCE, who presented a proposal for public relations agencies within the Divisions to seek outlet of news that casts credit on the entire profession.

Research procedures and standards programs, respectively, were reported in detail by Elmer K. Timby, chairman of the ASCE Research Committee, and F. Crampton Frost, American Standards Association representative.

Middlebrooks Memorial Fund Established

Several friends of the late Thomas A. Middlebrooks, A.M. ASCE, who died in February, have formed a fourteen-member committee for the purpose of establishing and endowing an ASCE Memorial Award in his honor. Friends of Mr. Middlebrooks desiring further information on the proposed memorial or wishing to contribute toward its endowment may get in touch with Wendell E. Johnson, M. ASCE, chairman of the committee. His address is Corps of Engineers, Office of the Division Engineer, Missouri River Division, P. O. Box 1216, Omaha 1, Nebr.



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MULTI-GROOVE AXLE AND BEARING prevent side play of telescope—structurally brace upper standards—keep out dust—retain lubricants—long-wearing—simple friction adjustment
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PATENTED ENCLOSED LEVELING SCREWS Replaceable unit—screw and bushing
STANDARD 3½in.-8 thread bottom plate and tripod head
EXTRA RIGID TRIPOD LEGS

Planning for the ASCE San Diego Convention, scheduled for February 7–12, 1955, is being handled by competent committees of San Diego Section members under the general chairmanship of Robert K. Fogg, immediate past-president of the Section. Shown here (front row, usual order) are L. L. Flor, Student Activities; E. A. Lawrence, Publicity; Mr. Fogg; ASCE Director M. J. Shelton; and Philip W. Helsley, Entertainment. In the back row are C. A. Smith, Finance; G. R. Saunders, Excursions; and T. G. Atkinson, Hotels. Other committee heads, absent when picture was taken, are R. S. Holmgren, Registration; Jean L. Vincenz, Technical Program; and L. W. Deewall, Reception.

EJC Members Attend Engineering Conferences in Brazil

With three international engineering conferences running more or less concurrently, Brazil has been the mecca this summer of a number of engineers from the United States. Engineers Joint Council was represented at all three gatherings—the third convention of the Pan-American Federation of Engineering Societies (UPADI) and the fourth conference of the Inter-American Association of Sanitary Engineering, held in Saõ Paulo, and a sectional meeting of the World Power Conference in Rio de Janeiro.

Almost 100 technical papers were on the agenda of the sectional meeting of the World Power Conference, which brought together an attendance of 526 in Western Hemisphere units of the international association. Coming out of the conference was a decision to admit Paraguay and Thailand to membership in the conference and to readmit Spain to membership. It was also decided that the World Power Conference will hold its fifth world-wide meeting in Vienna, June 18 to 23, 1956. A study tour of European projects will follow that conference. The following other meetings were also scheduled: International Executive Committee, Paris, May 31, 1955; Section meeting, Yugoslavia, 1957; Section meeting, Canada, 1958; Section meeting, Switzerland, 1960; and Sixth World Power Conference, 1962, country to be designated.

The UPADI conference in Saõ Paulo will be reported later.

EJC and ASCE contingent is part of group of 80 engineer representatives of industry and government leaving New York International Airport for engineering conferences in Brazil. Shown here (left to right) are Brig. Gen. Stewart E. Reimel, M. ASCE, secretary of EJC; Walter G. Whitman, chairman, Reactor Subcommittee, General Advisory Committee, AEC; Alex D. Bailey, past-president of ASME; Wilbur A. Dexheimer, M. ASCE, commissioner of U. S. Bureau of Reclamation; Mrs. Dexheimer; Eugene W. Weber, M. ASCE, International Joint Commission; and Gail A. Hathaway, Past-President ASCE and president of the International Commission on Large Dams, World Power Conference. Photo courtesy of Pan-American World Airways.

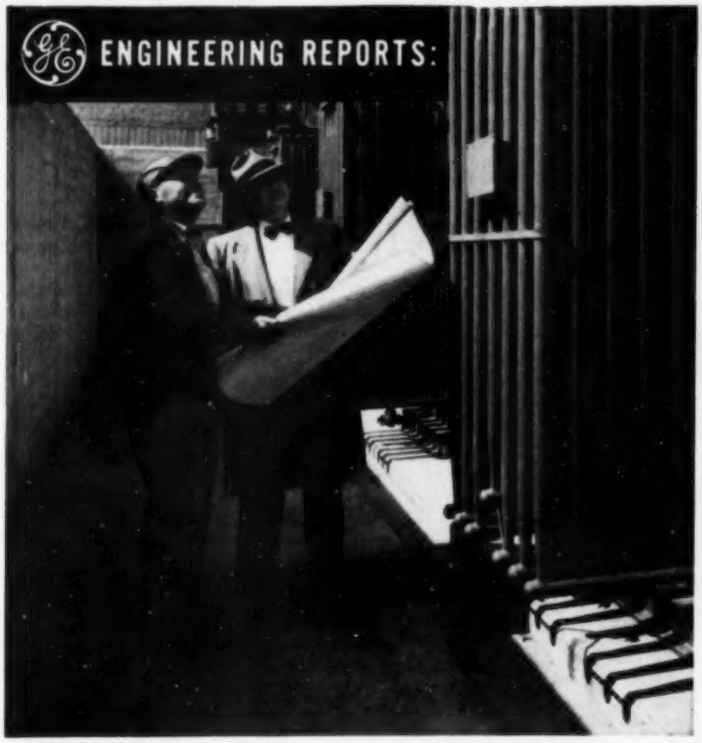
More Free Proceedings Separates to Be Distributed

Automatic free distribution of papers sponsored by the Technical Division in which a member is enrolled will continue for the present, as will blanket subscriptions at $12 a year for all Separates published each year. Furthermore, beginning October 1, 1954, all members of ASCE may obtain as many as 100 additional free Proceedings Separates, regardless of Division, by using the coupon customarily printed in the back pages of CIVIL ENGINEERING. However, in this free distribution by coupon, members will be limited to one copy each of any Separate.

The practice of offering members yearly subscriptions to the papers of specified Technical Divisions at $2.00 per Division will be terminated on September 30, 1954. Unpaid charges for subscriptions covering papers published from October 1, 1953, to September 30, 1954, will be included on the 1955 dues statements.

ASCE Manual Defines Surveying Terms

To keep pace with recent changes and modifications in the art and science of surveying, a committee established by the ASCE Surveying and Mapping Division has been working on a revision and enlargement of Manual No. 15, *Definitions of Surveying Terms* which was issued in 1938. The work of the committee is now available as Manual of Engineering Practice No. 34, entitled *Definitions of Surveying, Mapping, and Related Terms*. The new manual includes, in addition to the definitions of surveying terms, a selected list of useful charts and maps published by state and federal agencies, a bibliography



PROJECT CO-ORDINATION of electrical equipment for new pumping stations was handled by D. H. Bixby (right) of G.E.'s Louisville office, working with J. C. Jones, field supt., Central Contracting Co., and Marine Electric Co.

ENGINEERING ASSISTANCE on the project was made available to U.S. Army engineers through F. G. Perkins (center), G-E sales engineer.

G-E engineering service helps speed Louisville flood control

Expedites construction of 4 pumping stations by prompt delivery of all G-E equipment

In the $24,475,000 Louisville flood control project of the U.S. Army Corps of Engineers, General Electric project co-ordination service, in addition to application engineering, played an important part. Through this service, all G-E power distribution equipment ordered for four of the project's pumping stations was delivered either on or ahead of schedule. This helped the electrical contractors, Marine Electric Co., and the general contractors, Central Contracting Co., to work at top efficiency, expedited construction, and earned the praise of both the Army engineers and contractors.

G-E equipment, backed by G-E engineering services, can pay off on *your* heavy construction projects. Learn how by contacting your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, New York. 664-32

COMPLETE CONTROL of Shawnee station is provided by G-E 2400-v metal-clad switchgear consisting of 6 circuit breaker feeder sections.

INCREASED PROTECTION at the project's 34th St. pumping station is provided by 480-v G-E switchgear with 6 drawout air circuit breakers.

Engineered Electrical Systems for Heavy Construction

GENERAL ELECTRIC

of publications on surveying, and a listing of references to surveying, photogrammetry, and other engineering terms. The cost of the 200-page manual is $3.00, with the usual 50 percent discount to members of the Society. For convenience in ordering, a coupon is provided in the advertising section of this issue.

Charles B. Breed, Hon. M. ASCE, was chairman of the committee in charge of the revision. Others on the committee were B. Everett Beavin, Sr., George H. Harding, Arthur D. Kidder, H. Oakley Sharp, and Herman J. Shea.

Colorado Section Reports On Denver Subsoils

Availability of a comprehensive 62-page report of the Committee on Denver Subsoils of the Colorado Section, which has been four years in preparation, is announced by William R. Judd, chairman of the committee. Entitled "Borehole Data and Engineering Applications in the Denver Area," the report is the only one in the field. It includes a map of the city with over 1,000 borehole locations plotted on it and an overlay showing the thickness of overburden throughout the city; the logs of boreholes drilled for foundation investigations and for water supply wells; and a text outlining the critical soils in the area, such as highly compressible loessal soils and expansive clays, and describing their physical properties and damage to structures founded on them.

Publication of the report has been financed through advance sales, contributions, and the cooperation of the publishers, the Hotchkiss Mapping Co. (4055 Fox St., Denver 16, Colo.), from whom copies may be ordered. The price is $5 a copy.

Virginia Section Host to District Six Council

The needs of Junior Members and the Society's need for younger members were stressed in a two-day program comprising a meeting of the District Six Council at Staunton, Va., July 30 and 31, with the Virginia Section as host. In the leading talk at the banquet climaxing the first day, ASCE President Daniel V. Terrell called for a campaign within the Society "to interest more young men in the Society and in the profession of engineering." President Terrell was introduced by Presidential Nominee William R. Glidden, and Section President Tilton E. Shelburne presided. In a panel session on Junior Members, moderated by Stanley R. Navas, speakers representing the various Sections were given five minutes each to discuss what their Sections are doing to attract and hold young civil engineers.

In a panel discussion on Subsections, moderated by ASCE Assistant Secretary E. L. Chandler, the need for Subsections within the various Sections was covered. The Virginia Section proposes to establish Subsections at Roanoke, Richmond, Norfolk, and Newport News.

Represented in addition to the host Section were the Maryland, Pittsburgh, and West Virginia Sections.

Members and guests of the Puerto Rico Section, almost one hundred strong, hold their annual outing at the U.S. Naval Station, Roosevelt Roads, P.R., with the commanding officer, Capt. H. L. Ferguson, Jr., and other officers as hosts. Shown here, in front of the power plant, are (first row, left to right), Lt. (j.g.) D. W. Wittschiebe, Lt. (j.g.) V. B. Bandjunis, R. Reyes, F. Leon, J. M. Canals, Ken Ahbol, Miguel Rivera, and C. Miranda; (second row, same order) Capt. N. J. Drustrup, Lt. R. P. Barry, Don Deere, L. R. Cobos, William Hill, C. S. Canals, R. Lucchetti, and R. J. Auld; (third row, usual order) J. D. Cockey, Walter Potter, John Lewis, Dario Hernandez, Jorge Jimenez, S. G. Kadala, Jr., and Dr. Roberto Jimenez. The program included a Naval Air Show, in which a helicopter and several jet aircraft were parked on the line; inspection of the dry dock, largest in the Caribbean area; and other impressive sights. Photo courtesy U.S. Navy.

ASCE MEMBERSHIP AS OF AUGUST 9, 1954

Members	8,686
Associate Members	11,188
Junior Members	17,710
Affiliates	70
Honorary Members	44
Total	37,698
(August 10, 1953	36,472)

Coming Events

Los Angeles—All-day field trip and outing to China Lake on September 25, sponsored by the Section's Desert Area Branch and the U.S. Navy. Larry Coleman (Michigan 4211, Extension 456) will answer any questions. Dinner meeting of the Section's Sanitary Group at Taiix French Restaurant, September 22, at 6:30 p.m., and dinner meeting of the Soil Mechanics Group at the Rodger Young Auditorium September 15, at 6:30 p.m.

Mid-South—Annual meeting at the Hotel Lafayette, Little Rock, Ark., October 21–23. There will be an "Early Birds" party on the evening of the 21st.

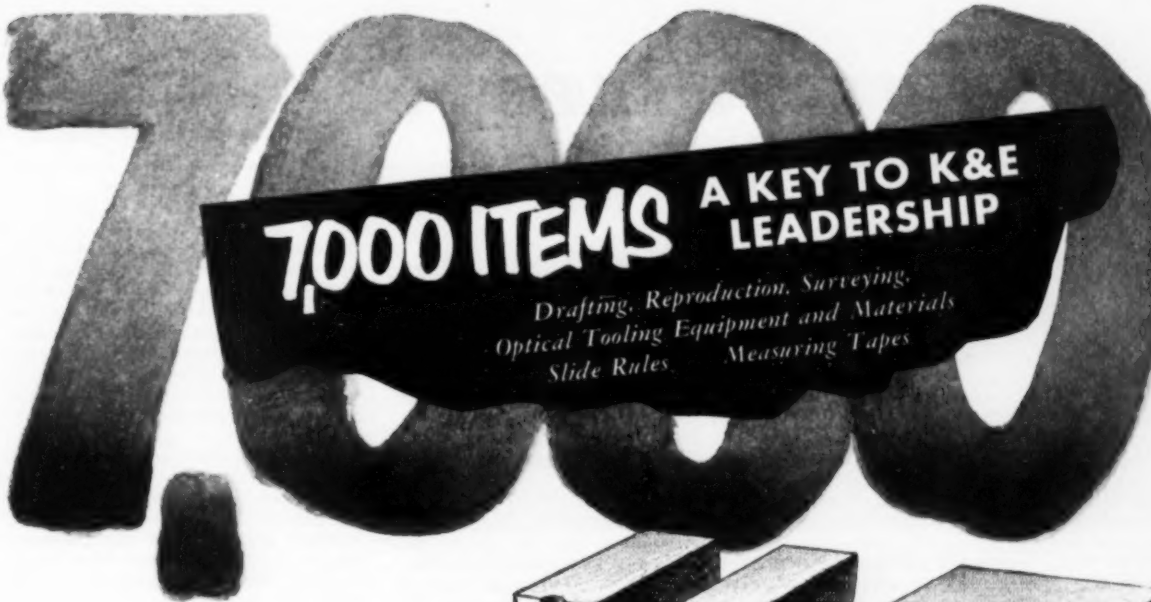
Texas—Fall meeting at the Rice Hotel, Houston, September 23–25.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N.Y.
Hotel Statler
October 18–22, 1954

SAN DIEGO CONVENTION
San Diego, Calif.
Hotel U. S. Grant
February 6–11, 1955

ST. LOUIS CONVENTION
St. Louis, Mo.
Jefferson Hotel
June 13–17, 1955



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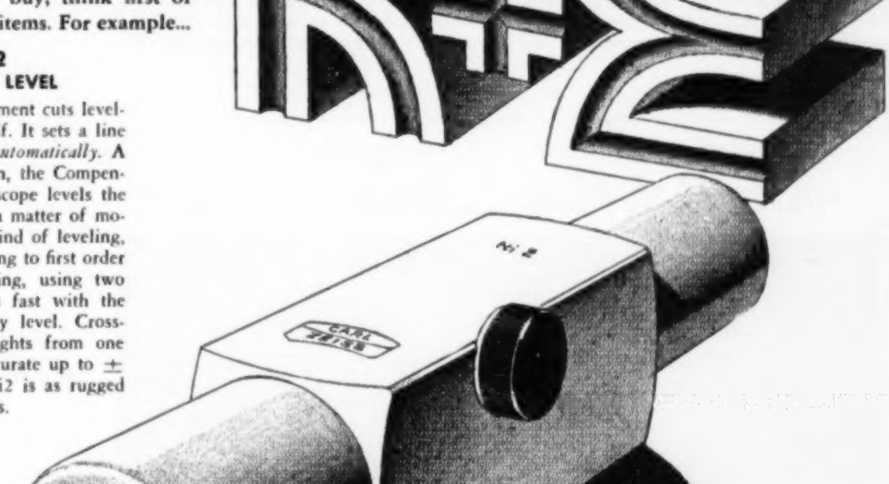

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NEWS BRIEFS . . .

Pan-American Highway Congress Meets at Caracas

Highway problems and planning of concern to both Americas were spotlighted during the ten-day program arranged for the Sixth Pan-American Highway Congress, held in Caracas, Venezuela, July 11–21. Nineteen American republics were represented by 367 delegates and observers at the congress, said to be one of the most successful ever held. The official United States delegation of eleven was headed by Walter Williams, Undersecretary of Commerce, and included two congressmen. ASCE was represented by E. W. James, member of the delegation and chief of the Inter-American Regional Office of the Bureau of Public Roads, who presented a paper speculating on the economic development of Central America and Panama that is bound to follow completion of the Inter-American Highway. Other ASCE members in the official delegation were Sewel M. Gross, of the American Road Builders' Association, and Francis C. Turner and Norman E. Wood, of the U.S. Bureau of Public Roads.

Contributing to the success of the congress was the postwar resurgence of interest in the Pan-American Highway. The reports of the interim committees, appointed at the fifth congress held in Lima, Peru, in 1951, were adopted without essential change. These reports covered the financing of the Pan-American Highway and the adjustment of common frontier points where agreement has not yet been reached.

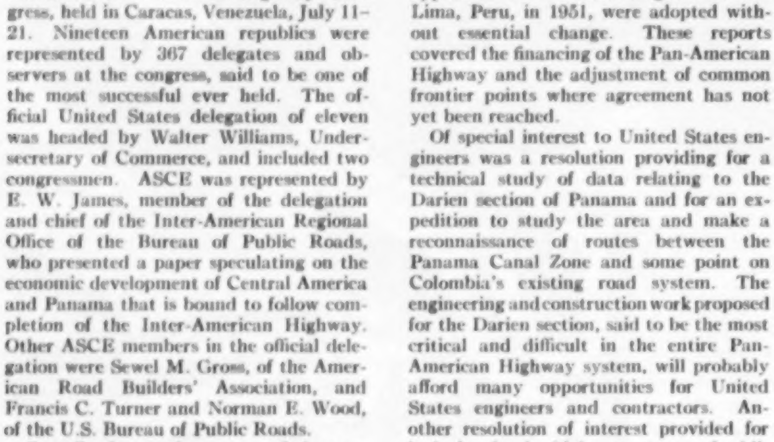
Of special interest to United States engineers was a resolution providing for a technical study of data relating to the Darien section of Panama and for an expedition to study the area and make a reconnaissance of routes between the Panama Canal Zone and some point on Colombia's existing road system. The engineering and construction work proposed for the Darien section, said to be the most critical and difficult in the entire Pan-American Highway system, will probably afford many opportunities for United States engineers and contractors. Another resolution of interest provided for inclusion in the highway system of additional land-water routes in the Gulf area to complete connections from Key West to the existing Inter-American Highway in Mexico and eastward from Havana, Cuba, to the eastern tip of Puerto Rico. It was recommended that the executive committee work with the governments involved to determine the best and speediest means of completing these Gulf and Caribbean circuits.

For the first time in the history of the congresses a resolution definitely stating the preference of the various countries represented for construction by contract methods was adopted. The discussions indicated a growing disposition to accept unit-cost methods of contracting in contrast with the cost-plus system that has generally prevailed in Latin America. Another resolution advocated formation of a Technical-Administrative Career Service in all the countries, which would in time build up a civil service engineering group of Latin American nationals.

The leadership of Venezuela in the organization and conduct of the congress, under the direction of both the president and minister of public works, was widely praised by the delegates. A number of interesting inspection trips had been arranged, and the delegates could take their pick of visits to oil camps, the U.S. Steel Corporation's facilities in eastern Venezuela, Pan-American Highway work in western Venezuela, and the spectacular new highways in and about Caracas.

Panama City was chosen as the site of the next congress.

Hoboken Pier to Provide Special Unloading Facilities



The American Export Lines, Inc., have signed a fifteen-year lease at an annual rental of over a million dollars with the Port of New York Authority for use of its new $6,300,000 Pier C (rendering above), part of a $15,000,000 Hoboken pier development project. When completed in 1956, the marine facility will consist of two new piers, a rehabilitated existing pier, and a recently modernized headhouse and upland area. Pier C, which has been under construction since September 1953, will be a steel and concrete structure 700 ft long by 328 ft wide, with 192,440 sq ft of covered space to handle cargo of two 12,500-ton ships of the Mariner class simultaneously. Two 500-ft-long depressed railroad tracks through the center of the pier and a third railroad track, 680 ft long, on the north apron will expedite handling of cargo direct from vessels. A continuous loop traffic lane will enable trucks to enter and leave the pier without turning around, permitting them to load and unload while on the pier. The structure will be entirely roofed with Robertson Q-deck.

Contract Let for Delaware River Bridge Superstructure

The New Jersey Turnpike Authority and the Pennsylvania Turnpike Commission have jointly awarded a $10,991,362 low-bid contract to the American Bridge Division of the U.S. Steel Corp. for construction of the superstructure of the new bridge across the Delaware between Burlington, N.J., and a point near Edgely, Pa. Construction of the bridge will require about two years.

A key link in the direct connection between the two turnpikes, the 6,571-ft, six-lane bridge will expedite traffic movements to and from the north, south, and west. The direct connection also involves completion by the Pennsylvania Turnpike Commission of a 32-mile extension between its present eastern terminus near Valley Forge to the eastern approach of the bridge. Part of the extension is being opened to traffic in August, and the rest of it will be ready by October, the fourteenth anniversary of the Pennsylvania Turnpike system.

Prestressed Concrete Bridge To Span Lake Pontchartrain

Plans for construction of a 24-mile causeway-type bridge to connect the northern and southern shores of Lake Pontchartrain in east Louisiana are going forward, with recent award of a $30,677,-210 low-bid contract for the bridge and its approaches to the Louisiana Bridge Co.—a joint venture group consisting of Brown & Root, of Houston, Tex., and T. L. James, a New Orleans contractor. The two-lane structure will be built on 54-in.-dia circular piles of prestressed concrete, making it the largest prestressed concrete project built to date. It consists of 2,237 identical 56-ft spans and, in addition, two steel bascules and a reinforced concrete turn-around in the center. Height above lake level is 20 ft.

The project was designed by Palmer & Baker, of Mobile, Ala., for the Parishes of St. Tammany and Jefferson. The Freyssinet Co., Inc., of New York, is consultant on the prestressed concrete work. It is expected that arrangments for financing will be completed in September, with construction to start soon thereafter.

New Projects to Relieve Golden Gate Bridge Traffic

Use of heavy equipment speeds construction of two new traffic lanes and a second highway tunnel which will relieve a long-existing bottleneck on the northern approach to the Golden Gate Bridge across San Francisco Bay. The approach section, called Waldo Grade, is part of U.S. Highway 101 and has peak-hour commuter traffic of nearly 3,000 cars. The current $7,000,000 improvement program, which will eventually become part of a $13,000,-000 freeway system from the Golden Gate Bridge northward through San Rafael, involves conversion of the existing four-lane highway to a three-lane thoroughfare for southbound traffic into San Francisco and construction of three new lanes for northbound traffic as well as construction of another highway tunnel. The Guy F. Atkinson Co., of San Francisco, was awarded the first contract for the project for $4,122,382—one of the largest single highway contracts in the state's history. Here the contractor is using a Caterpillar Diesel DW20 Tractor with No. 20 Scraper push-loaded by a D8 Tractor equipped with a No. 8S Bulldozer.

Construction Equipment to Be Leased by Clark Co.

Further evidence of a buyer's market in construction equipment, if any is needed, is given by the Clark Equipment Co., with announcement of a lease plan. Through the newly formed Clark Leasing Co., Michigan power cranes and Michigan tractor shovels can now be obtained on a lease basis with or without option to buy. Terms of the lease are for three or five years. This is believed to be the first time a manufacturer of construction equipment has made such a plan available.

The effective annual simple interest paid by the customer for leasing is 3.79 percent of the cost of the equipment. The terms of the lease are such that the full purchase price of the equipment is returned over the period of the lease.

The customer is responsible for maintenance, insurance, and any other costs resulting from operation of the equipment. Included in the lease is an option for the customer to extend the lease indefinitely at a low cost.

Among the reasons for leasing advanced by the company are the following: Leasing enables a contractor to retain working capital which may be required for more immediate needs such as purchasing materials, increasing payroll costs, or purchasing other capital equipment not available under a leasing plan, and to obtain construction equipment for immediate use on a monthly expense basis. Leasing also eliminates the necessity for a firm to obtain a capital appropriation before major items of new equipment can be ordered and placed in use.

With the leasing plan already in operation in the Industrial Truck Division of Clark, records show that 15 to 20 percent of its business has been through the lease plan, and two-thirds of this was new business.

Construction a Major Market for Steel

Construction and contractors' products are more than ever a mainstay of the steel industry, according to the American Iron and Steel Institute. These market groups received about as much steel (3,000,000 tons) in the first quarter of the year as in the same period last year. They required 20 percent of the direct shipments of finished steel in March this year. For March 1953 the figure was lower—17.1 percent. In the past fourteen years, the 125,800,000 tons of steel used by the construction and contractors' product groups exceeds the total for any industrial category.

Shipments of heavy structural shapes were about 120,000 tons higher in the first quarter of this year than in the same period last year. Shipments of steel piling were slightly higher, and shipments of plates and reinforcing bars were slightly below the totals in the first quarter of 1953.

Government Nickel Plant To Enlarge Its Capacity

Two firms have been selected by the National Lead Co. for the construction work required to expand its nickel plant at Nicaro, Cuba. They are the Frederick Snare Corp. and the Merritt-Chapman & Scott Corp., both of New York and Havana. The Office of Defense Mobilization has authorized the investment of up to $43,000,000 for the overall work of enlarging the capacity of the government-owned installation by 75 percent. The General Services Administration is responsible for both the operation and expansion of the plant, and the National Lead Co. is the operating contractor.

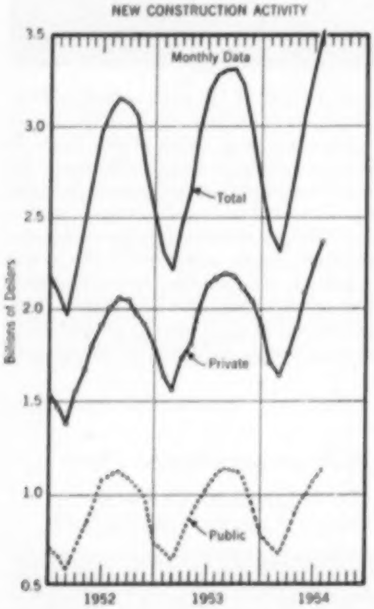
Perini Buys Bay State Dredging & Contracting Co.

Purchase of the Bay State Dredging & Contracting Co., of Boston, is announced by B. Perini & Sons, Inc., of Framingham, Mass. Acquisition of the company and its partly owned subsidiary, the North Atlantic Dredging Co., adds to the Perini construction interests an established dredging and waterfront construction subsidiary.

July Construction Activity at Record Level

Expenditures for new construction rose seasonally in July to a new monthly peak of $3.5 billion, reaching a record total of $20.1 billion for the first seven months of the year, as reported in preliminary estimates prepared jointly by the U.S. Departments of Commerce and Labor. After adjustment for seasonal factors, new construction activity in July was at an annual rate of $37 billion.

Expenditures for total private construction, commercial buildings, churches, schools (private and public), and sewer and water facilities were at an all-time monthly high in July, and also set a new record for the January-July period. In addition, outlays thus far this year were at peak for private residential buildings, public utilities, and highways. Increases in July were about seasonal for most major types of construction. Industrial and hospital building (private and public) remained steady, while public housing continued the down-trend that began a year ago.



Seasonal rise of construction expenditures in July to new monthly peak of $3.5 billion is shown in Department of Commerce curves.

The value of new work on private residential building totaled more than $1.2 billion in July 1954. This was 10 percent above July 1953, and exceeded the level of all months since October 1950. The high dollar volume of expenditures reflected a greater-than-usual rise in non-farm starts during June.

Comparing the record volume for January–July 1954 with that for the first seven months of 1953, private expenditures ($13.8 billion) were 4 percent higher, and public outlays ($6.3 billion) were about the same. Increased spending by state and local governments offset a decrease in federal spending. The greatest dollar gains over the first seven months in 1953 have been in offices, stores, and other kinds of commercial building; private residential building; road construction; and educational (private and public) building, in the order named. January–July expenditures for sewer and water systems, public utilities, churches, and recreational facilities are also substantially higher this year than last.

On the other hand, federal outlays for military facilities are down so far this year by almost two-fifths. Thus far expenditures have also been considerably less for both private and public industrial building, public housing, farm construction and conservation and development work (river and harbor, flood control, and reclamation projects). Public industrial building is down because of a drop in the rate of plant expansion for production of military items, which more than offset an increase in installations for the Atomic Energy Commission. Although public spending for hospital construction has been slowing down this year, activity in the field may receive a boost from recently enacted legislation authorizing a new program of assistance to the states for building diagnostic and treatment centers, chronic disease hospitals, rehabilitation facilities, and nursing homes.

Islands to Be Built in Atlantic for Radar Chain

To close a gap in the nation's radar defenses, the Air Force will build a series of "islands" out in the Atlantic—some of them as far as 125 miles out at sea. The string of huge platforms, which will be placed along the Continental Shelf between Virginia and Newfoundland, will be an adaptation of the "Texas Towers" successfully used for oil-well-rig foundations in the Gulf of Mexico.

Made by the DeLong Corp., of New York, the "Texas Tower" consists of a steel barge on which are mounted a series of steel tubes or caissons, 6 ft in diameter and more than 100 ft long. Each platform will probably have an area of 15,000 sq ft, sufficient to provide housing for a crew of twenty to thirty men. It will also have a heliport, since servicing must be by helicopter. In installation the barge is towed to a location where the water is less than 100 ft deep, and the tubes, or caissons, are dropped through holes in the platform to the bottom. The platform is then raised above water level and fastened in place by means of an intricate pneumatic system that involves deflating and inflating sets of rubber tubes—one set of two tubes each for each caisson. The caissons will ultimately be pile driven to the bottom and then filled with sand or concrete.

Test borings are already being made along the coast in a joint Army-Navy-Air Force project, and it is expected that construction will begin next spring. The cost of each structure is estimated at about $750,000, exclusive of radar equipment, with the cost of the chain between $15,000,000 and $20,000,000—considerably less than the present cost of radar protection by picket ship.

Swiss Instrument Firm to Be Represented in U. S.

Kern & Co., Ltd., of Aarau, Switzerland, announces it will have direct factory representation in this country, with opening of Kern Instruments, Inc., 120 Grand Street, White Plains, N.Y. Kern Instruments, Inc., will be headed by Hans Winkler as president and Florian E. Davatz as executive vice-president and sales manager. Since 1819 Kern & Co., Ltd. have been manufacturing precision surveying and drawing instruments. They also make the lenses for which Bolex amateur movie cameras are famous, as well as other optical and precision instruments.

Additional Units Planned For Brookhaven Laboratory

Selection of the Stone & Webster Engineering Corp. as architect-engineer of building and supporting facilities for the 25 billion-electron-volt proton synchrotron to be built at the Brookhaven National Laboratory at Upton, L.I., is announced by the Laboratory.

Though the machine itself will be designed and built by members of the Brookhaven Accelerator Development Department, Stone & Webster will design and supervise construction of its housing and complementary equipment. This includes a doughnut-shaped tunnel, 20 ft in cross section, with foundations to support the 3,000-ton magnet it will cover; heavy materials-handling equipment; water-cooling systems and air temperature controls; and a large building to house the control room, laboratories, offices, electronics shops, and other services.

Awarding of Professional Degrees Studied by ECPD

A survey of professional-degree awarding by various engineering institutions has been completed by the Recognition Committee of the Engineers Council for Professional Development, under the chairmanship of R. H. Barclay. The survey, which is said to be one of the most comprehensive of its type ever undertaken, will serve as a basis for formulating recommendations concerning the practice of awarding the professional degree as a means of professional recognition.

The response to the survey was exceptionally good, with 142 of the 146 engineering schools queried returning the questionnaires sent them. Of the 86 schools awarding the degree, 74 use professional experience as a basis for making the award, eight require resident graduate study, and four include both professional experience and resident graduate study as prerequisites for awarding the degree. An increase of approximately 80 percent in the award of professional degrees in the past five years, as compared with the previous five-year period, is also reported. However, approximately 20 percent of the schools offering the professional degree are making plans to drop it.

Steel Company Opens New Facilities at Ashland, Ky.

Completion of a $10,000,000 expansion program at its Ashland (Ky.) Works is announced by the Armco Steel Corp. New facilities at the Ashland plant, in addition to the $40,000,000 hot strip mill completed last year, include a four-high, 58-in. cold reversing mill, a continuous strip pickler, and two of the company's Zincgrip lines—one heavy and one light gage—for coating strip steel with zinc in a continuous operation.

The new facilities embody the latest developments and improvements in steel-plant equipment design. The cold reversing mill is powered by motors with a total of 4,500 hp, and can turn out cold reduced strip at a maximum speed of 1,650 fpm. It processes strip up to 48 in. wide.

Several Contracts Let For Lincoln Tunnel Tube

A $1,270,000 contract for construction of a ventilating building for the third tube of the Lincoln Tunnel has been let by the Port of New York Authority to the low bidder, the Colmar Construction Co., of Brooklyn. To be erected on West 38th Street, east of Twelfth Avenue, the 155-ft-high structure has been designed to span the roadway so that traffic will not be impeded. It will be 118 ft long and 60 ft wide. Construction will start in November and be completed in 1956, a year before the tube is opened. A contract has already been let for a ventilating tunnel on the New Jersey side.

The Port Authority has also voted award of a $1,563,000 low-bid contract for a new Lincoln Tunnel administration building at the tunnel plaza in Weehawken to James Mitchell, Inc., of Jersey City. A $1,862,851, contract covering miscellaneous projects involved in building the third tube has been let to the Grow Construction Co., of New York. Contracts awarded to date on the $100,000,000 third-tube project total $45,000,000.

Huge Power Development Planned for British Columbia

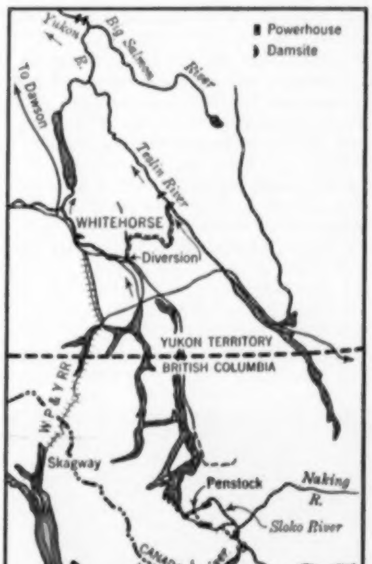
Major power developments and metallurgical projects are currently being planned for northern British Columbia and the Yukon. The development, which calls for harnessing the waters of the upper Yukon, is being undertaken by Northwest Power Industries, Ltd., a subsidiary of Quebec Metallurgical Industries, Ltd., and Frobisher, Ltd., a subsidiary of Ventures, Ltd. Work will begin next year, assuming the necessary licenses can be obtained from the Canadian and British Columbia governments.

Covering a water-storage area second only to that of the Great Lakes, the watersheds to be developed extend 200 miles in a north-south direction—from the southern end of Atlin Lake to the mouth of Big Salmon—and 300 miles in an east-west direction. Studies and surveys made to date show a potential development of more than 4,300,000 hp in the area—about twice that of the St. Lawrence Seaway Project.

Essentially the hydroelectric power phase of the project, officially known as the Yukon River–Atlin Lake–Taku River Power Project, calls for utilizing the runoff from the upper drainage system of the 2,000-mile Yukon River, which flows across Alaska and into the Bering Sea. By constructing a system of dams and mountain tunnels, and by making use of existing lakes and valleys, the upper Yukon flow as well as flow from adjacent watersheds will be diverted to the valleys south of Atlin Lake, and will eventually empty into the Pacific by way of the Taku River south of Juneau, Alaska. The diverted flow will be used to generate power through plants to be built in the Sloko, Nakonake, and Taku river valleys.

Three main dams will form reservoirs for storage of water in high-flow periods for release in the low-flow winter months. One dam will be built four miles upstream from Whitehorse, another on the Teslin River 40 miles north of Teslin Lake, and the third just below the confluence of the Yukon and Big Salmon rivers. Two tunnels through the mountains (one a mile long and the other 9.7 miles long) will carry water from Atlin Lake to the Nakonake River, providing an estimated maximum output of 2,800,000 hp. In a later stage of the development a third tunnel, driven between the Nakonake and the Taku river valleys, will generate an additional 1,500,000 hp.

Cost of the first stage of the project, which is scheduled for completion in 1962, is estimated at $269,950,000. Of this amount, $212,750,000 will be spent in developing the 880,000 hp of electrical energy involved in the first stage. The remaining $57,200,000 will be required to construct the necessary smelters and refineries for treating the ores and concentrates.



Flow of Upper Yukon will be diverted south by system of dams and tunnels to provide power for metallurgical projects. Power plants will be built in the Sloko, Nakonake, and Taku river valleys. Eventually part of the Yukon flow will go into the Pacific by way of the Taku south of Juneau, Alaska, instead of into Bering Sea as at present.

Austria and Germany Collaborate on Hydro-Power Development

New $28,632,000 hydro-power plant on the Inn River between Austria and Germany is a joint project of the two countries and will supply 513,000,000 kwhr annually to the two countries in equal amounts.

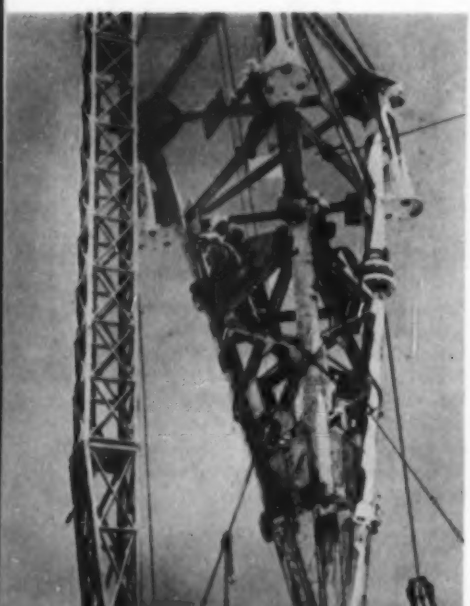
Construction of the Braunau hydroelectric power plant, a joint project of Austrian and German power companies, has been characterized by the United Nations as a spectacular example of international cooperation and one worthy of emulation by other European governments. The first unit went on the line in the fall of 1953, and the last this May. The hydro-plant and its history are of interest from both an economic and technical point of view.

Situated on the lower part of the Inn River near its confluence with the Danube, the Braunau plant utilizes the water of the Danube, which forms the border between Germany and Austria. As always in the erection of a border power plant, there were legal problems to be solved before construction could start. In April 1951 Austria and Germany established the Oesterreichisch-Bayerische Kraftwerke Aktiengesellschaft, which was charged with the erection of the border plant and with apportioning construction costs equally between the two countries. It also had to arrange for dividing orders between firms of the two countries and, last but not least, to see that the energy produced by the completed plant was fed equally into the Austrian and German transmission systems. The cost of the plant is estimated at $28,632,000.

A number of hydroelectric power plants are already in operation along the Inn River, and the erection of further plants is intended. All these projects, in existence and planned, had to be taken into consideration when planning the Braunau plant. Investigations proved that a head of 38 ft would be available at average flow, of 40 ft at minimum tailwater, and of 19 ft at maximum tailwater. Five gates, each $75\frac{1}{2} \times 48\frac{1}{4}$ ft, are provided. The four vertical-type generating units form a power plant of the outdoors type, the only protection provided for the generators being removable covers. The capacity of the Kaplan turbines is 30,800 hp each, at 8,900 cfs, and their height is 37 ft. The powerhouse is situated on the right, or Austrian, bank of the river, with the weir gates on the Bavarian bank. The outdoors-type switching station, containing four transformers for 32 mva is also located on the Austrian side.

The head obtained causes a $5\frac{1}{2}$-mile backwater of the Inn River itself and involves also its tributary Salzach in a backwater of almost $2\frac{1}{2}$ miles. The backwater will form a lake, covering 3.8 sq miles and necessitating the construction of five dams—two of them, with a length of 5.9 miles, in Austrian territory and three of them, 9.1 miles long, in Bavarian territory.

Steel sheetpiles were driven into the ground as far as the watertight strata, in order to avoid seepage of water. Several pump stations were provided behind the dams for drainage of low-lying land. Special measures were required because the plant was to be erected by two adjacent countries. The building site was designated an international zone which could be entered from either Bavarian or Austrian territory, but currency and valuables of either country must be placed on deposit before the building site can be entered. Within the international zone a specially issued "canteen-money," printed



World's Tallest Steel Structure Goes Up in Oklahoma

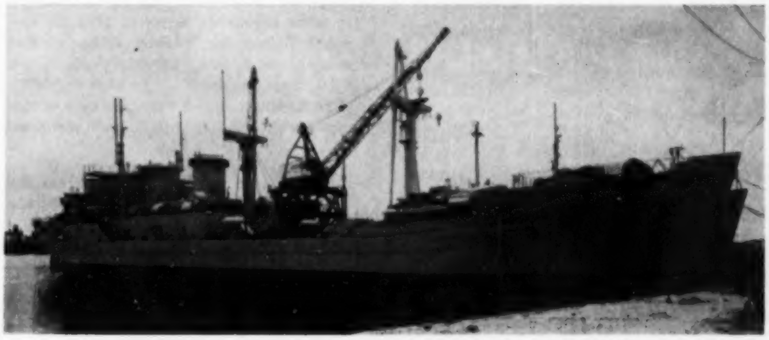
Highest assembled steel structure ever erected is the TV tower under construction for Oklahoma City's Station KWTV. The tapered base of the 1,572-ft guyed tower is shown in the illustration as a 100-ft electric gin pole lowers a section into position for bolting the leg flanges. Legs are $10\frac{1}{2}$-in. forged steel rounds, to which heavy circular flanges and wing or gusset plates are manually welded in the shop. Girts and diagonal bracing can then be bolted to the legs by field crews. In all there are 52 sections stacked up for the complete tower, topped by two antennas—78 and 73 ft high. The tower is designed to withstand loads up to 60 psf on the upper half and 40 psf on the lower half. The entire weight of the tower (1,323,392 lb) is carried by a porcelain insulator, consisting of 21 oil-filled tubes of 4-in. dia that can handle an estimated maximum working load of 1,400 tons. Shop welding of the leg sections at the plant of the Ideco Division of the Dresser-Stacey Co., Columbus, Ohio, was expedited by use of the Lincoln Electric Company's new Jetweld Electrodes. Orville Pelke was design engineer on the project for the Ideco Division.

in Austrian shillings and German marks, is used. Both countries guarantee duty-free importation to all goods destined for consumption on the building site, including food and building materials.

In a normal year energy output of the plant will be 513,000,000 kwhr, which will be fed in equal parts into the German and Austrian interconnected system—176,000,000 kwhr during the winter months and 337,000,000 kwhr during the summer months. The energy output of the plant is especially important to the aluminum plant at Ranshofen, in the immediate vicinity of Braunau.

[*The material for this item was supplied by Dr. Erwin Konigshofer, of Vienna.*]

Navy Dedicates Huge Mobile Generating Plant



World's largest mobile electric generating plant goes into U.S. Navy service following recent dedication ceremonies conducted by Rear Admiral John R. Perry, chief of the Bureau of Yards and Docks. Identified as the YFP-10, the 6,000-ton floating power house was converted at the Gibbs Shipyard from the cargo ship, "Coastal Racer," at a cost of $5,800,000. It is 338 ft long and 50 ft wide and has an electric power output of 34,500 kw, sufficient to meet the emergency needs of a large city or a major naval or military installation. Use of an existing freighter hull saved approximately $4,000,000 over the cost of building a shore plant of equal output, according to the Gibbs Corp., which designed and carried out the extensive hull and structural alterations. Reynolds, Smith & Hills, Jacksonville engineering firm, designed the power plant itself. The generators, which are powered by oil-fired steam turbines, can put out full load within four hours of the initial light-off. Though the propulsion engine was removed to make room for the generating plant, the YFP-10 can go anywhere with the aid of a tug.

USBR Awards Contract For Davis Aqueduct

The United Concrete Pipe Corp., of Baldwin Park, Calif., has been awarded a $3,896,146 contract for construction of Davis Aqueduct, a feature of the Bureau of Reclamation's Weber Basin Project in north-central Utah between Ogden and Salt Lake City. The contract calls for about 18 miles of pressure pipe in diameters ranging from 48 to 84 in., which will be installed along a route beginning at the Weber Aqueduct at the mouth of Weber Canyon and extending along the foothills of the Wasatch Mountain, south to the Davis-Salt Lake County line. It will have an initial capacity of 350 cfs, a terminal capacity of 30 cfs, and will furnish irrigation water in addition to supplying municipalities along its course.

The Weber Basin Project, which comprises some 2,500 sq miles, is a multiple-purpose development designed for maximum utilization of water and related resources in a fast-growing section of the state.

Bidding Competition Stiff on Long Island

Bidders' pencils are really sharp in New York. A contract to excavate 50,000 cu yd for a Long Island recharge basin was low bid at a lump sum of one cent ($.01) or about two hundred-thousandths of a cent per cu yd. High bid for the job was $13,975.00.

In commenting on two other bids of $.98 and $1.00, an official of the Davis Construction Co., low bidders, noted that "they were foolish for bidding so high." Incidentally, the low bidder was not civic minded. He intended to use most of the sand and gravel excavated and could sell the rest.

Nuclear Notes

V—Natural Radioactivity (Part 1)

"Nuclear Notes" are prepared for the Sanitary Engineering Division by its Committee on Sanitary Engineering Aspects of Nuclear Energy. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which includes S. T. Barker, A. E. Gorman, Prof. Warren J. Kaufman, and James G. Terrill, Jr. Next month's subject will be: "Natural Radioactivity" (Part 2).

Radioactivity is not a discovery of the Atomic Age, which began in 1942; the phenomenon was observed first by Becquerel in 1896. By 1912 more than 30 naturally radioactive materials had been identified, and at the present time over 40 radioactive species or radioelements of high atomic weight are known to exist in nature. In addition, a few of the lighter elements—namely, potassium, rubidium, samarium, lutetium, and rhenium—possess feeble natural radioactive properties.

The present discussion relates to knowledge synthesized from a study of these naturally occurring radioactive materials as differentiated from those produced in the atom smashers or particle accelerators available to modern physicists.

By means of suitable chemical procedures, it has been shown that uranium, thorium, and actinium could be separated into fractions of variable activity. These studies indicated that certain precipitates had activities considerably greater than the initial or parent substance and that, if allowed to stand, the activity in the precipitate would decrease, whereas that in the parent substance would soon increase to approximately its initial value. The separations could be repeated many times, always with the same result. Experiments showed that the loss in activity was related exponentially to the time, such that the number of atoms decaying in any given interval of time was proportional to the number of atoms present at that time. This may be stated mathematically as follows:

$-\dfrac{dN}{dt} = \lambda N$, which when integrated becomes

$\ln (N_t/N_0) = -\lambda t$ or $N_t = N_0 e^{-\lambda t}$. Converted to logarithms with base 10,

$\log (N_t/N_0) = -0.4343\ \lambda\ t$, or $\log N_t = \log N_0 - 0.4343\ \lambda\ t$.*

Where

N_0 = the number of atoms present at time zero

N_t = the number of atoms present at any time t

λ = radioactive constant, time^{-1}

The radioactive constant λ is a specific property of a given radioelement and may be used to characterize the radioelement. Plotting the log of N_t against corresponding values of time, one obtains a straight line. The slope equals $-0.4343\ \lambda$, thus giving the value of λ. This equation can be applied to atoms which disintegrate rapidly (very short half life—seconds or less), as well as to those which decay slowly (long half life—10^8 or more years).

Since the rate of decay is exponential, an expression to define the life of a radioisotope is convenient, and the term half life has been introduced. This is the time required for the radioactivity of any given amount of the element to decay to half its initial value. This time, T, can be evaluated from the last expression given above. After a lapse of time T, the number of radioactive atoms N_t will be half the initial number N_0, so that $N_t/N_0 = 1/2$. Inserting this value in the equation and replacing t by the half life T, is it seen that

$$\log 1/2 = -0.4343\ \lambda T \text{ or } \log 2 = 0.4343\ \lambda T, \text{ and } T = \frac{0.693}{\lambda}.$$

As indicated previously, each radioactive atom of a given species occurring in nature upon disintegration expels from its nucleus either one alpha or one beta particle. The number of atoms disintegrating in a given time, hence the rate of disintegration, could be evaluated from a knowledge of the decay scheme and from counting the number of alpha or beta particles emitted. To calculate the half life of a given radioisotope, the radioisotope is counted at various time intervals and a plot is prepared of $\log I_t$ vs. time, and the equation obtained takes the form

$$\log I_t = \log I_0 - 0.4343\ \lambda\ t.$$

Here I_t is the indicated count obtained by instrument and represents the number of disintegrating atoms that were "counted." Since the plot for a single isotope is a straight line, the slope can be determined. From this the decay constant or half life is obtained, and the intercept, I_0, corresponding to time $t = 0$, may be found.

There are three naturally occurring radioactive series, namely, the uranium, thorium and actinium series. They take their name from the radioisotope with the longest half life in each series. Scientists predicted a fourth series, which prediction was substantiated with the discovery of neptunium, an artificially produced radioisotope. Since it has a half life of only 2.20×10^6 years, and since the earth is believed to have been formed about 2.5×10^9 years ago, calculations show that if this isotope occurred naturally at the start of the earth's formation, it would have decayed to such a low level that it could no longer be detected in its original form but would have decayed to non-radioactive bismuth. The neptunium series also differs from the other series in that its end product is bismuth, whereas in the case of the other three series the end product is a stable isotope of lead.

The formulas cited here are of extreme practical importance since they are used in performing all calculations relating to decay and half life.

[Suggested reading: *Sourcebook of Atomic Energy*, by Samuel Glasstone, D. Van Nostrand Co., Inc., New York, N.Y. (1950); see pp. 109–129.]

* The form of this equation is one with which engineers are familiar, since it is used extensively in hydraulics, sanitary engineering, and chemistry.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M.ASCE

The September meeting of the Engineers Club, as always, was well attended, for vacations were over and everybody had a story to tell of the fish he caught, the miles he drove, or the iniquitous charm of a newly opened mountain resort. Everybody, that is, but Professor Neare, whose garrulousness made him most conspicuous during his infrequent absences.

"He's on a field trip," explained Sauer Doe, "with a bunch of engineers who call themselves 'ferrets,' inspecting and appraising old culverts. But he phoned to ask me to resume as Guest Professor and, predicting that no one would have solved the problem of the ripped redwood post, asked me to give a few broad hints and reassign it."

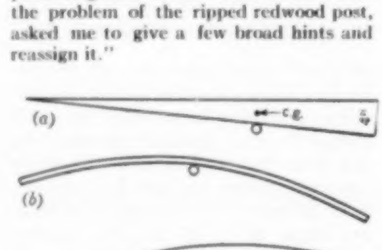


Fig. 1. Joe's wedge (a), with centroid above pivot, wouldn't teeter without tottering, but the analogy of the bent wire (b) inspired Cal to conceive (c) of the wedge bending to stability under its own weight.

"That's an insult," howled Joe Kerr. "Ripped diagonally, each piece of the 4×4 is a wedge, with a long triangular section, so when he balanced it on the wire clothesline, the required distance from wire to butt-end must have been one-third the length of the post. Why, everbody knows the balance point is at the centroid and the centroid of a triangle is a third the way from base to vertex."

"That's logical, so far," conceded Professor Doe, "but you haven't answered the precise question, 'How far must it have been from the wire to the butt-end?' The question asks for a minimum distance; it must have been so far, *or farther*."

"Well, the length of the post wasn't given, but whatever the length, I say the distance was a third as much, no more and no less."

"Now we're going around in circles, so let's look at another stipulation, that the piece balanced on the wire 'in a *teetering* position.' Did it occur to you that if the centroid of the wedge is above its pivot on the wire, it would balance delicately in one position and lose its balance if it started to teeter?"

"No, I never," admitted Joe, "but I could rip the post with a notch up to the centroid so that it would teeter and not totter. The answer would be substantially the same."

"But the piece would no longer be one of 'two equal tapered pieces' nor would the post be cut 'diagonally.' Let's look at balance in another way. If a straight piece of wire were bent like a hairpin and hung on a clothesline, it would balance in a teetering position, wouldn't it?"

"Sure."

"And less bending, up to a minimum, would yield the same result?"

"Sure, until the centroid of the wire was at the pivot."

"And a longer wire would bend more easily?"

"That's the tip-off!" yelled Cal Klater. "The wedge-shaped piece of redwood balanced at its third point bends under its own weight, lowering its centroid. If the piece is long enuf, the centroid is at or below the pivot, and it teeters, so this critical length can be computed."

"Which is still a nice problem for reassignment," concluded Professor Doe. "For a check, let's take redwood's weight at 27 pcf and elasticity at 1,200,000 psi."

[Guest Professor Sauer Doe (Marvin Larson) guarantees there is no gimmick in the reassignment, but just an interesting task with one surprising result. Allusion to the Board of Ferrets is premonitory of a future culvert assignment.]

RUGGED CONCRETE PIPE WITHSTANDS THE SEVERE STRESSES OF JACKING OPERATIONS

The photo shows 84-in. concrete pipe being jacked under several railroad tracks to provide protection for a 48-in. water main of the Metropolitan Utilities District in Omaha. The entire operation was performed during the winter months without any more interference with traffic than the observance of a slow order.

It's another example of how sturdy concrete pipe meets almost any combination of site or soil conditions or drainage requirements. Concrete pipe also stands up under heavy traffic impact, high fill loads and severe climate.

You usually save money by jacking concrete pipe because you minimize roadbed disturbances under railways, highways and streets. Thus you reduce or eliminate costly maintenance often caused by trench fill settlement.

In addition to its superior strength and ease of installation concrete pipe offers:

1. MAXIMUM HYDRAULIC CAPACITY—assured by smooth interior walls, clean, even joints and freedom from damaging internal corrosion.

2. EXTRA LONG LIFE—proved by long years of dependable service in thousands of installations.

3. OUTSTANDING ECONOMY—resulting from moderate first cost, extra long life and little or no maintenance expense. These factors mean ***low annual cost***—the true measure of pipe line performance.

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GRIT removal and washing

For Sewage Plants,
Lift Station Wet Wells,
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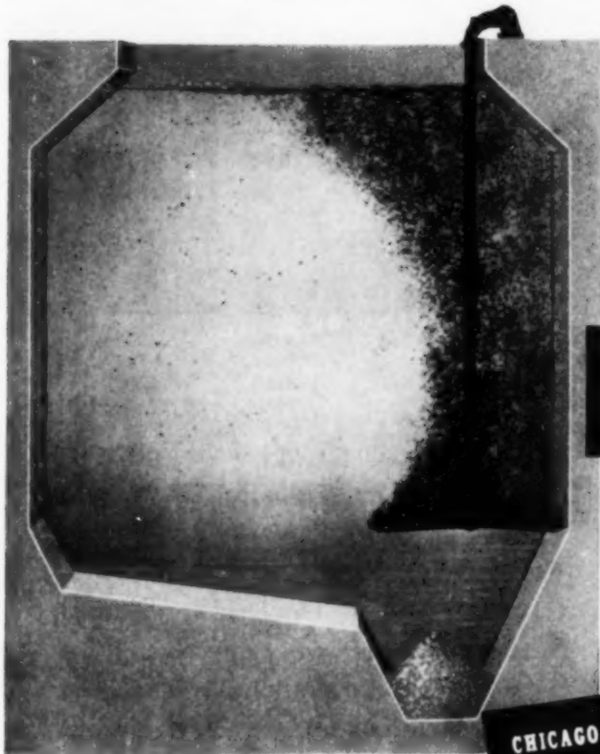
Intakes, Processing and
Packing Plants, Dairies



CHICAGO SEWAGE EQUIPMENT

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Efficient over a Wide Range of Flow

Air diffused into the grit removal tank circulates liquid upward from the bottom of the tank. Organic material is "scrubbed" off the surface of the grit by thousands of tiny air bubbles. Cleaned grit moves to the less agitated side of the tank and settles into the hopper. Amount of air supplied to the tank can be varied to maintain proper settling velocities over a wide range of liquid flow.

Here's the grit removal system that gives superior performance *plus* the advantage of low installation and maintenance costs. Only a simple structure is required—grit is cleaned so thoroughly during removal that separate washing tanks are not needed. Tests on grit removed from sewage flows by the Aer-Degritter* have consistently shown less than 0.05% putrescibles.

Because the Aer-Degritter* has no mechanical equipment that can be clogged by coarse sewage or waste matter, it can be located ahead of all pumps and other mechanical equipment. The air diffusion equipment may be raised easily from the tank, permitting convenient access to the grit hopper for periodic emptying.

Over 60 Aer-Degritters* are now in operation in large and small plants. Write for complete details.

**The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,328,655 and No. 2,555,201.*

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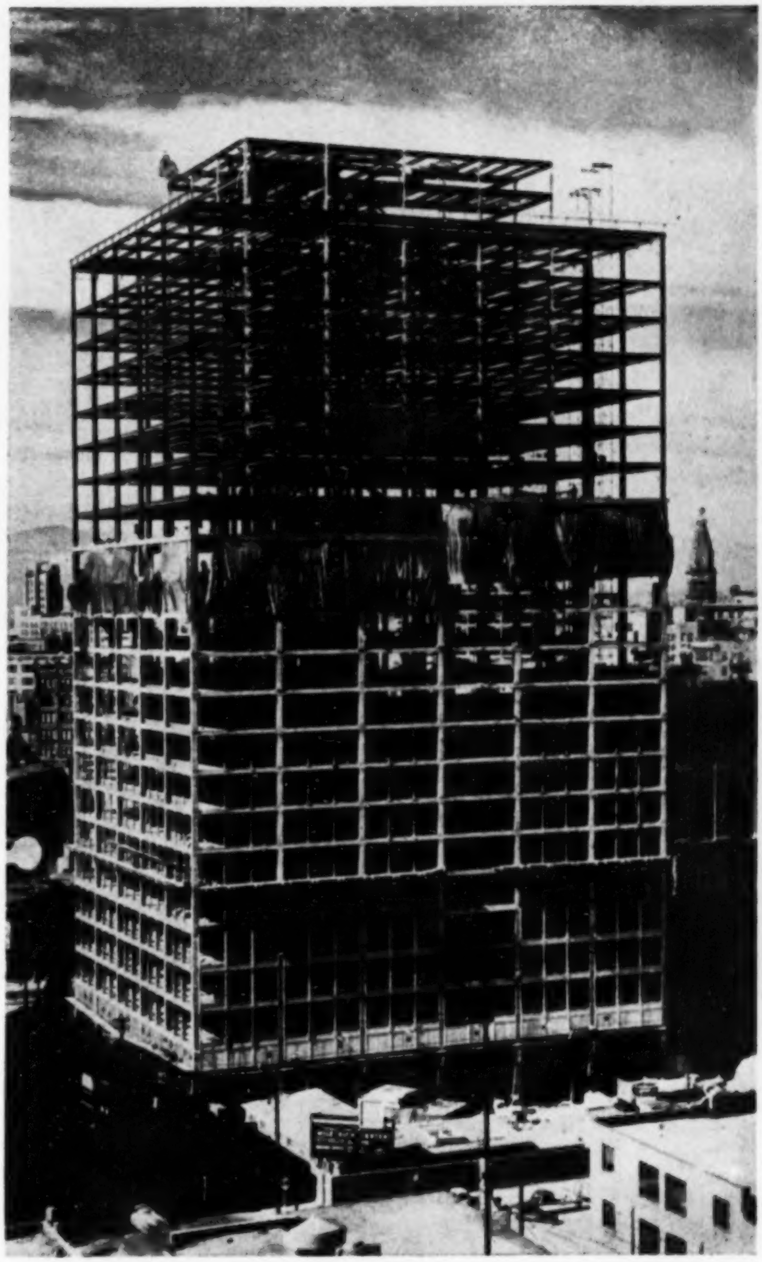
Steel for Denver's Mile High Center Erected in 82 Days



A remarkable new building is rapidly nearing completion in Denver, right across the street from the famous old Brown Palace Hotel. It is 1700 Broadway, a striking 23-story office building, principal structure of the spectacular "Mile High Center."

Fully air-conditioned, equipped with electronically-controlled elevators, and featuring an open ground floor and dramatic new facade treatment, the tall, graceful tower strikes a new note in beauty and efficiency. The Mile High Center will also include a handsome bank and office building, and a two-story structure housing a clear-span airline terminal on the street level, with a restaurant and shops below.

HIGH-STRENGTH BOLTS SPEED ERECTION

One of the eye-opening aspects of 1700 Broadway is the speed with which Bethlehem erected the 4600-ton steel framework. By using high-strength bolts instead of field-driven rivets, Bethlehem's erection crew was able to complete bolting the same day they finished steel erection—trimming a full week off erection time. Averaging better than 55 tons of steel per day, Bethlehem completed the entire job in just 82 working days.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Completed structural steel framework of 1700 Broadway. Pouring of concrete and installing of aluminum cover panels was well under way when this picture was taken. *Owner:* Webb & Knapp, Inc., and George A. Fuller Co. *Architect:* Webb & Knapp, Inc., Architectural Div., I. M. Pei, director. *Associated Architects:* Kahn & Jacobs and G. Meredith Musick. *Consulting Engineers:* Jaros, Baum & Bolles and Severud-Elstad-Krueger. *Contractor:* George A. Fuller Co. *Steelwork:* Bethlehem Steel Co.

High-strength bolting, pioneered by Bethlehem, requires a minimum of men and equipment, speeds and simplifies erection.

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Tractor mounted. New claw-action feeder with automatic release. Loads earth, etc., at 4 cu. yd. per min. Snow at 7 cu. yd. per min. Ten-foot discharge height. Eight-foot boom overhang. Self propelled at 10 m.p.h.

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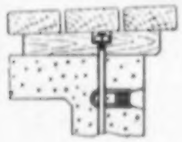
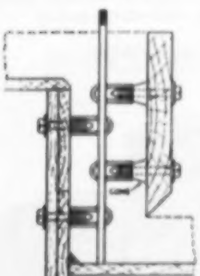
Building a Grandstand, Stadium, Balcony?

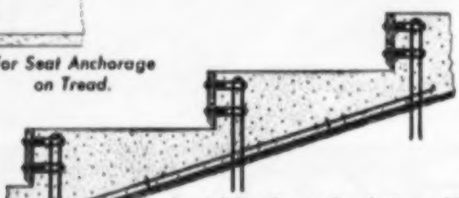


The advantages of Superior Riserframes have been demonstrated and proved in the construction of hundreds of grandstands, stadiums, and balconies of auditoriums and theatres.



For Seat Anchorage on Tread.

The front riser form is accurately supported, spaced and aligned by the Riserframe to which it is secured by temporary coil bolts. After stripping, seat brackets are easily attached with permanent ½" coil bolts which engage the coil sockets embedded in the concrete. For seat anchorage on treads, Riserframes with ½" diameter cold rolled rods, threaded at one end, are used for the vertical connection as shown in drawing at left. A nut secures the metal bracket or wooden seat bolster. For decks on fill there are special Riserframe units as shown below.



Special Riserframes for decks on fill. Units may contain 2, 3, or 4 supports.

On your next job . . . use Superior Riserframes. There is a type of Riserframe for any possible job requirement. A preliminary layout and estimate will be prepared from your plans without charge or obligation. For additional details request a copy of our complete 60-page catalog.

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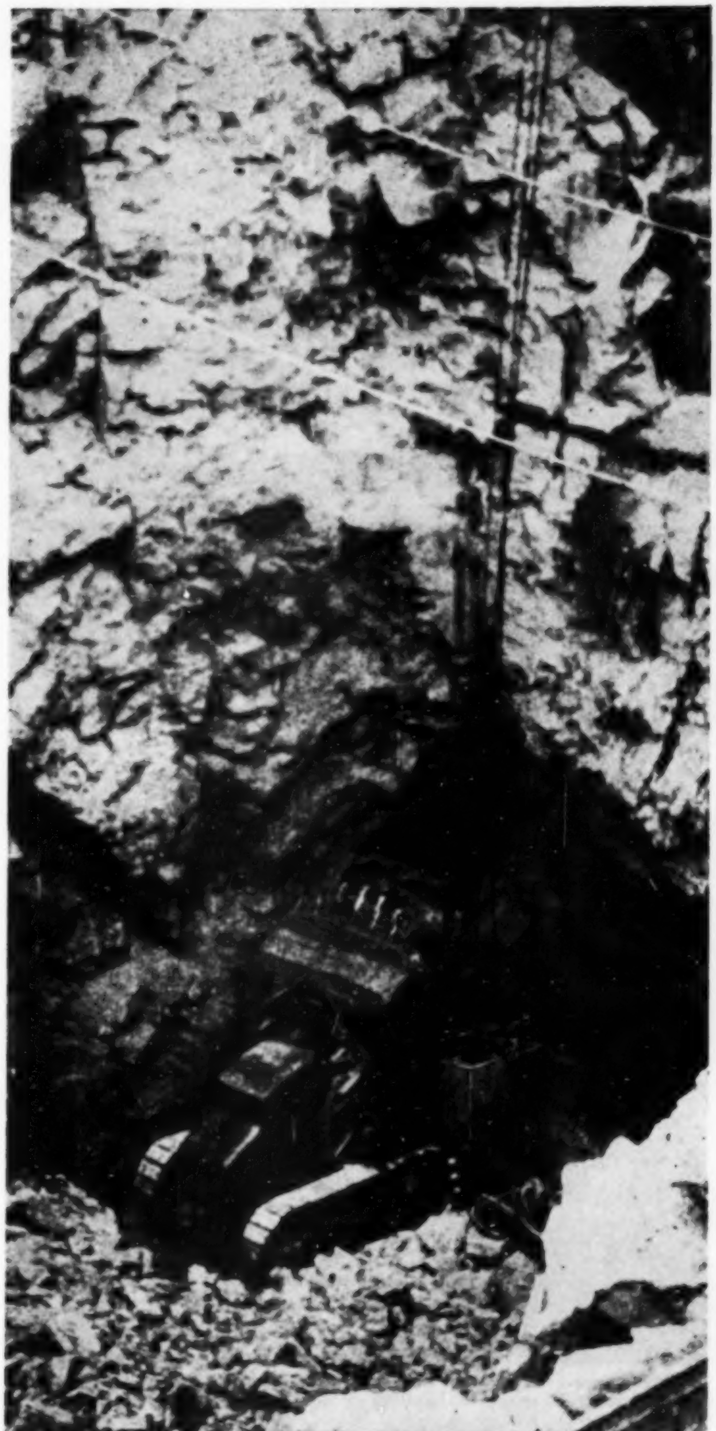

SHAFT SINKING WITH EIMCO TRACTORS

Eimco 105 tractors with excavating attachment are being used for mucking hard rock shafts on the Quebec Hydro job. The 105's are lowered into the shafts and dig their way down to the bottom of the blasted rock.

This is the toughest kind of work for any excavating equipment—only the Eimco was equal to the job. During the long winter, work continued on the job which required all types of well known heavy construction equipment of many makes and when spring came and the accounting was done, the Eimcos showed a higher percentage of availability than any similar equipment.

Eimco equipment is built for these harder than usual jobs. Heavy steel castings are used throughout on the 105. Greater maneuverability makes it usable on jobs where confined areas only are workable. Being able to dig below grade makes it practical in shaft work.

Wherever the going is tough — you'll find the best equipment for tractor, bulldozer or excavator work is the Eimco 105.

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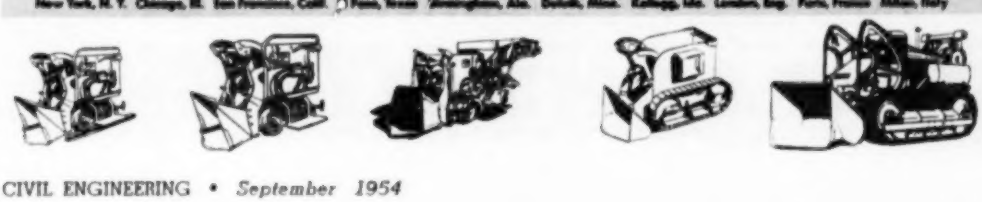
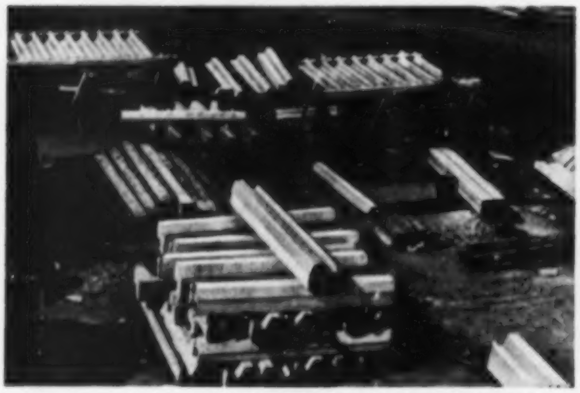
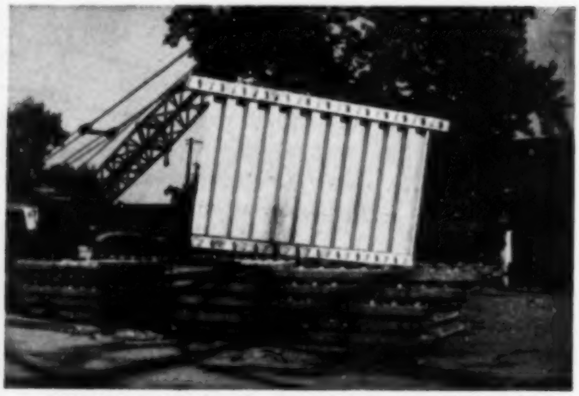


JOB-SITE "ASSEMBLY LINE" SPEEDS RETAINING WALL ERECTION

Here's how good planning and Armco Bin-Type Retaining Walls can solve the problem of unstable slopes quickly at low cost.



Transverse sections, which form the bin sides, are assembled on the job near a stockpile of parts. Individual metal units are delivered ready to be bolted together.



As sections are needed, they are lifted into place without delay. They are set vertically at 10-foot intervals to provide, in effect, sturdy girders that keep the wall stable under load.

Wall takes shape as the side panels are placed, and stringer units are added to form front and back. Base plates under vertical columns provide foundation. Little excavation is needed.

Completed bins are backfilled while adjoining bins are still being erected. Earth itself is used to provide weight and stability. There is no delay for curing. There are no forms to strip.

Write us for details. We'll be glad to send you complete information on Armco Bin-Type Retaining Walls. Armco Drainage & Metal Products, Inc., 4234 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO

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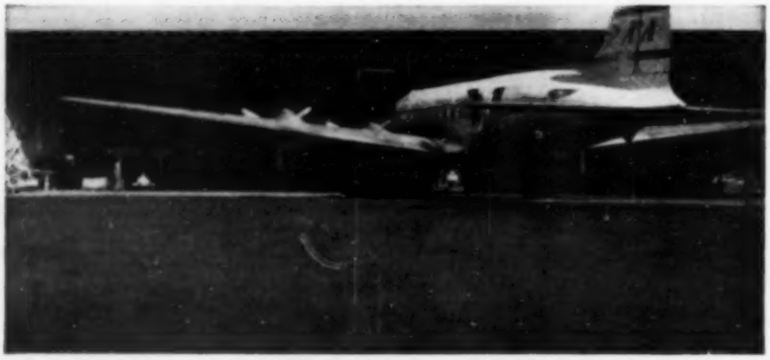

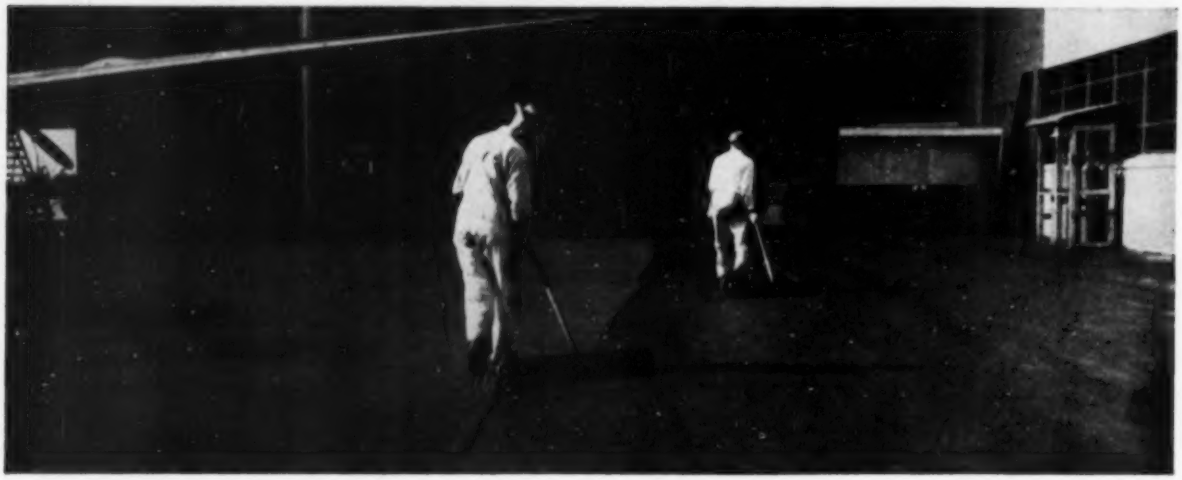

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10,000 sq. yds. of Hanger Apron and Fueling Area for Pan American Airways Corporation at the Seattle-Tacoma International Airport were recently sealed with Colfix Jet Seal—for protection against wear, weather and solvent action of fuels.

This job was let at a contract price of under 6¢ per sq. ft. Work began with cleaning of the area, followed by a rapid squeegee and broom application of diluted Colfix Primer. This method assures good bond even to a dusty surface, and gives added insurance against fuel transmission in vapor form.

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Following the prime, Colfix Jet Seal, mixed with some water to free-flowing consistency, was applied with rubber-faced squeegees. Three applications were made in order to get smooth, uniform coverage of one quarter gallon per square yard (based on the material as received in the container). Each squeegee application was brushed immediately and the area opened to traffic as soon as the Jet Seal had set.

For Safety ... and Long Life

Colfix Jet Seal embodies a coal tar base and oil-proof elastomers that provide an enduring solvent-resistant seal for all bituminous pavements. Its value has been proved on numerous airport runways, parking areas and hard-stands where it effectively protects these surfaces against the solvent action of gasoline and aircraft fuels. In addition, it provides a durable, skid-proof surface that resists heat and weathering.

Colfix Jet Seal is a "bodied" product that fills surface voids. It requires no sand cover. Jet Seal is one of the easiest materials to apply by squeegee, brush or industrial spray equipment. It sets rapidly and the sealed surface may be opened to traffic with a minimum of delay.

For full information on Colfix Jet Seal call our office nearest you.

Here's another typical Colfix Jet Seal job at Baltimore's Friendship International Airport.

Colfix Jet Seal is made by the makers of Walk-Top and Wearcoat—protective coatings for Playgrounds and Tennis Courts used successfully for over 20 years.

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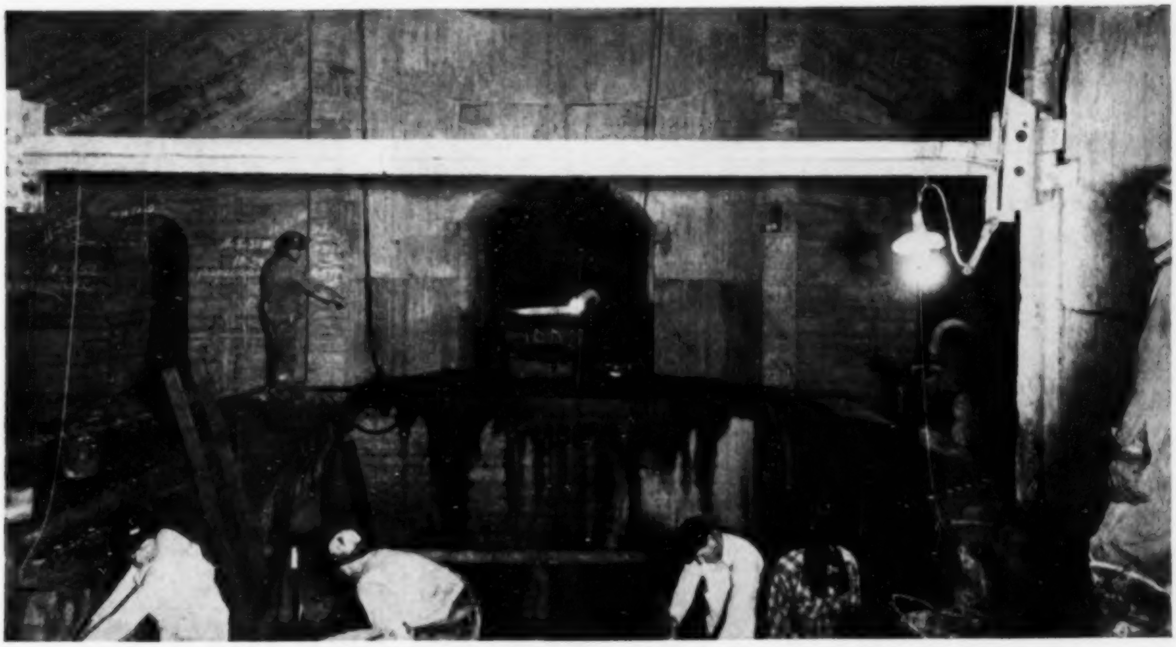
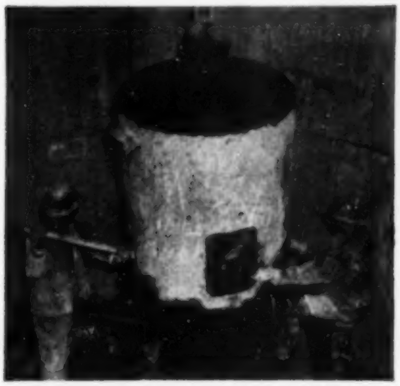
Oakland 1, Calif. Portland 7, Ore. Washington 5, D. C. San Juan 23, P. R.



Concrete shaft lining at Bowlby Shaft, No. 2 Mine Butts, Robena Mine, Greene County, Pa. Contractor: R. G. Johnson Company, Washington, Pa. Forms are removed in the sump and bottom arches.

Contractor Counts on Duraplastic* For Better Results in Mine Shaft Linings



Pouring the last of the concrete into a 6" pipe to fill bottom arches at Bowlby Shaft.

"We've used Atlas Duraplastic in a large number of shafts and have always had excellent results," says C. H. Dorsey, president and treasurer of the R. G. Johnson Co., Washington, Pa. "Duraplastic helps us overcome the water hazard of shaft sinking. We've found that it gives shafts longer life."

Contractors prefer Duraplastic air-entraining portland cement for general concrete work because it gives concrete superior workability, greater plasticity. This makes placement easier. Work progresses smoothly and rapidly . . . often means savings in both time and money.

Duraplastic minimizes bleeding, or water gain, and segregation . . . fortifies concrete against the effects of freezing-thawing weather. Mixes are more cohesive, more uniform . . . less mixing water is needed for a given slump. And concrete made with Duraplastic offers increased resistance to water penetration. No wonder so many contractors are specifying Duraplastic for all their construction jobs.

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** "Duraplastic" is the registered trade-mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.*

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DECEASED

Casper Dull Meals (A.M. '22), age 63, since 1937 chief engineer of the wire rope division of the Bethlehem Steel Co., Williamsport, Pa., died on April 27. Before joining Bethlehem, Mr. Meals was employed by John A. Roebling's Sons, Co., Trenton, N.J. (1911–1922); the American Cable Co., New York (1924–1930); the New York Cordage Co., New York, and the Wire Rope Corp. of America, Inc., New Haven, Conn. (1930–1931); and the B. Greening Wire Co., Ltd., Hamilton, Ontario (1931–1937). Mr. Meals attended the Drexel Institute of Technology.

Ernest Dale Middaugh (A.M. '42), age 45, consulting engineer and head of Ernest D. Middaugh & Associates, Rockford, Ill., died recently. Before entering private practice, Mr. Middaugh was with the City of Flint, Mich. (1928–1930); the Olds Motor Works, Lansing, Mich. (1930–1935); the Francis Engineering Co., Rockford (1938–1942, 1947–1952); and the Stewart-Warner Corp., Dixon, Ill. (1943-1946. He attended Michigan State College.

Leon Alfred Paddock (M. '47), age 75, former president and director of the American Bridge Co., Pittsburgh, Pa., died in that city on July 27. During Mr. Paddock's connection with the company—from 1931 until his retirement in 1946—it fabricated the steel work for the San Francisco - Oakland Bay Bridge, the Empire State and Chrysler buildings, Radio City and other famous structures. Becoming connected with the Canadian Bridge Co. in 1904, Mr. Paddock was named president in 1924, and remained in that capacity until 1927. He was a graduate of the University of Michigan.

Leon A. Paddock

Edward Pennock Palmer (M. '20), age 69, president of Senior & Palmer, Inc., New York construction firm, died at his home in Stamford, Conn., on July 12. He was associated with the firm as secretary-treasurer from 1929 to 1942 and since 1942 as president. Previously (1921-1929) Mr. Palmer was secretary for Arthur McMullen, Co., New York. Mr. Palmer was engaged in the construction of early subways, and the anchorage of the New York side of the George Washington Bridge. He had been president of the Associated General Contractors and director of the U.S. Chamber of Commerce, and was a recipient of the 1953 Moles Award. He was an alumnus of Swarthmore College.

Claud Russell (M. '23), age 69, civil engineer of Manila, P.I., died there on April 28. After graduating in 1907 from the University of Kansas, Mr. Russell entered the Philippine Islands Bureau of Public Works, advancing from assistant engineer to director in 1918. From 1919 to 1928 he was general manager of the National Coal Co., for the Philippine government. He was then engaged in private practice and maintained his relations with the government as director of the National Development Co., and the Cebu Portland Cement Co. At the time of his death he was with the Atlantic Gulf & Pacific Co.

Arthur Winthrop Sargent (M. '17), age 83, who retired in 1941 after 38 years of service in the U.S. Engineer Department at Seattle, Wash., died at Stanwood, Wash., on June 2. Mr. Sargent participated in design, construction, maintenance and operation of lock and dam construction work in the Puget Sound area and on the Lake Washington Ship Canal.

Tashiro Shiraishi (M. '22), age 66, president of the Shiraishi Foundation Co., Tokyo, Japan, since he founded the firm in 1933, died on July 6. Mr. Shiraishi previously had been an assistant engineer for

(Continued on page 112)

Deceased

(Continued from page 111)

the Japanese Imperial Government Railway (1912–1918); president of the Komatsu Iron Works (1918–1923); consulting engineer for the Tokyo Reconstruction Bureau (1923–1933); and a lecturer in the civil engineering department of Tokyo Imperial University, his alma mater.

John Alfred Stalfort (M. '50), age 66, president of the Consolidated Engineering Co., Inc., of Baltimore, Md., died at his home in that city on July 14. After graduating from Cornell University in 1910, he became associated with Henry S. Rippel of Baltimore. At the time of the organization of Consolidated Engineering in 1911, Mr. Stalfort was named chief engineer and estimator, advancing in 1938 to the presidency. Under his leadership the firm participated in construction of some of the largest buildings in the Baltimore and Washington, D.C., area, including the Department of Commerce and the House office buildings, and the Library of Congress annex.

William Foster Trimble Jr. (A.M. '21), age 60, president of the Trimble Co., Pittsburgh, Pa., died at Bellevue, Pa., on June 18. Entering the family firm in 1919, Mr. Trimble became president in 1937. Pittsburgh structures erected by the firm include the Bell Telephone, Post Gazette, and Pennsylvania Warehouse buildings. Mr. Trimble graduated from the University of Pittsburgh in 1916.

Charles Leopold Wartelle (M. '44), age 69, who retired in 1947 as chief engineer of the Seattle (Wash.) engineering department after 40 years of service, died at his summer home on Camano Island, on June 1. Mr. Wartelle had been head of the department for ten years prior to his retirement. He was an alumnus of Louisiana State University.

Walter Owen Washington (M. '19), age 70, consulting engineer of Brownsville, Tex., and former county engineer for Cameron County, Texas (1920–1939), died in Brownsville on July 4. Mr. Washington was a partner in the San Antonio firm of Whitaker and Washington from 1910 to 1923. At various periods he held the positions of construction engineer on the water control and irrigation canal program of Willacy County; city engineer of Brownsville; supervising engineer for the Defense Plant Corp. at Corpus Christi and Ingleside; and engineering consultant to the International Boundary Commission. From 1945 to 1950 he was partner in the firm of Washington and Ruff in Brownsville. He was an alumnus of the University of Texas.

W. O. Washington

New Publications

Air Pollution. Publication of the *Air Pollution Abatement Manual*—in preparation by the Manufacturing Chemists' Association—is now completed, with issuance of Chapter II, "Terminology and Selected Data." Eleven other chapters, plus a preface and outline of the manual, have previously been published as separates. On request, single complimentary copies of the full thirteen-chapter manual will be supplied to federal, state, and municipal officials directly concerned with air-pollution control. For others the price is $6 each with binders. Prices of the individual chapters range from 15 to 75 cents, with Chapter II selling for 75 cents. Requests should be sent to the Manufacturing Chemists' Association, Inc., 1625 Eye Street, N.W., Washington 6, D.C.

Modular Coordination. To acquaint construction superintendents and foremen with modular dimensioning, based upon the generally accepted ASA 4-in. module, the Housing and Home Finance Agency has made available an illustrated pamphlet entitled *Building Better from Modular Drawings*. William Demarest, Jr., is the author. Copies are for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 20 cents apiece.

Puerto Ordaz Ore-Handling Plant. The story of the development of the Orinoco Mining Company's rich Venezuelan iron-ore deposit is told in two reprints from CIVIL ENGINEERING (December 1953 issue) published by the Link-Belt Co. as Book No. 2509. The two articles cover the story of the discovery of iron ore on Cerro Bolivar and describe the 6,000-ton-per-hour ore-handling system at Puerto Ordaz. Free copies are available from the Link-Belt Co., 307 Michigan Ave., Chicago 1, Ill.

Community Planning. Issuance of a revised and enlarged edition of *The Community Builders Handbook* is announced by the Urban Land Institute. The new (fourth) edition, which is divided into sections on residential development and the planning of shopping centers, is intended as a working guide for everyone concerned with planning, financing, building, selling, and operating a successful community. The editors are Max S. Wehrly and J. Ross McKeever. Copies of the 300-page publication, priced at $12, are for sale by the Urban Land Institute, 1737 K Street, N.W., Washington 6, D.C.

Construction. The Bureau of Labor Statistics of the Department of Labor has published a collection of historical statistics on construction, entitled *Construction During Five Decades*. Identified as Bulletin No. 1146, the publication may be obtained from the Superintendent of Documents, Washington 25, D.C., for 45 cents.

Bibliography. Two pamphlets—a bibliography of reports on "Effects of Bombing on Industry" and a bibliography of reports on "Water Softening"—have been issued by the Office of Technical Services in the Commerce Department. They are available at 10 cents each from Department of Commerce field offices or from the Department in Washington.

TVA Hydro Plants. Engineering work involved in the design of electrical installations for the primary water control structures of the Tennessee Valley Authority is described in Volume 2, *Electrical Design of Hydro Plants*, recently issued as Technical Report No. 24 in the series entitled Design of TVA Projects. Copies of the 449-page buckram-bound publication may be purchased from the TVA Treasurer's Office, Knoxville, Tenn., for $2.25.

WASHO Road Test. A comprehensive description of the WASHO project, methods of test operation, and instrumentation procedures is given in Special Report 18 of the Highway Research Board. The purpose of the report is to provide the basis for a complete understanding of the test and the test pavements as they were actually constructed. A second report, to be published in 1955, will give the results of the imposed truck traffic. Special Report 18 sells for $2.25, and may be obtained from the Highway Research Board, 2101 Constitution Ave., Washington 25, D.C.

Structural Design. Constants for design of continuous girders with abrupt changes in moments of inertia are studied in the recently released Bulletin 176 of the Iowa Engineering Experiment Station. The authors are R. A. Caughey, M. ASCE, professor of civil engineering at Iowa State College, and Richard S. Cebula, head of the engineering department at St. Martin's College, Olympia, Wash. Free copies of the bulletin are available from the Experiment Station, Iowa State College, Ames, Iowa.

Soniscope Tests. Results of field soniscope tests of concrete conducted by the Waterways Experiment Station for the Office of the Chief of Engineers have been made available in Technical Memorandum No. 383, which may be obtained from the Station at Vicksburg, Miss., for 50 cents. The soniscope is an instrument that transmits pulses of ultrasonic sound through materials and measures electronically the transmission time. These transmission times can easily be converted to velocity values if the pulses are transmitted across a known path length. The measurement of the velocity of an ultrasonic pulse through concrete provides a non-destructive means of determining an index of the condition of the concrete. The purpose of the tests reported in Memorandum No. 383 was to determine pulse velocities at selected typical locations in certain concrete specimens and structures (four dams and one lock).

Building Industry. In a recent brochure entitled *Technological Research and Construction Markets*, the Construction and Civic Development Department of the Chamber of Commerce of the United States calls on the construction industry to take a major step forward by formulating a building science which will expand markets for the construction industry's services and products." The brochure states

(Continued on page 115)

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All applications should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of \$3.50 per quarter or \$12 per annum, payable in advance.

Men Available

Construction Engineer, M. ASCE; background of excellent performance in varied types of construction; has done industrial, Army and Navy bases, public buildings, roads and bridges; also knowledge of all types of excavation. Prefers working in the East but will go anywhere if mutually satisfactory. C-989.

Professional Civil Engineer; J. M. ASCE; 28; married; children; 8 years' reinforced concrete and steel design and detailing; desires instructor's position with opportunity to pursue graduate work. Location preferred, South and east Atlantic. C-990.

Civil Engineer; J. M. ASCE; 32; married; A.B., mathematics, 1943; B.S.C.E., 1948; 1 year's experience municipal engineering; 3 years' experience structural steel design, detail and take-off; 2 years' experience contract engineering. Location preferred, East Coast or South. Available, mid-September. C-991.

Bridge and Building Engineer; J. M. ASCE; 29; B.S. and M.S. in C.E.; good knowledge of and experience in reinforced and prestressed concrete. Desires to work with concrete product company to open the field in making prestressed concrete structural elements. C-992.

Civil Engineer; J. M. ASCE; 26; single; B.S.C.E., 1952; 21 months administration and supervision of overseas construction contracts with Corps of Engineers. Desires responsible work in construction, municipal or highway field. Location preferred, western U.S. or foreign. C-993-SF-2-6-San Francisco.

Civil Engineer; J. M. ASCE; aggressive, age 32; M.S. in C.E. and business administration; has diversified experience in designing, estimating and construction of concrete and steel structures. Desires permanent position with managerial responsibilities. Assistant to chief engineer or project manager. Location no problem. C-994.

Positions Available

Civil Engineer, 26–30; for estimating and valuation of buildings and structures for fire insurance purposes. Salary, \$4,500–\$4,800 a year. Location, New York, N. Y. Y-9852.

Civil Engineers. (*a*) Civil Engineer, graduate, with some municipal experience, particularly on streets and sewers. Salary, \$4,170–\$5,670 a year. (*b*) Junior Civil Engineer, graduate, with about a year's experience in general civil engineering and some knowledge of streets and sewers. Salary, \$3,500–\$4,100 a year. Must be residents of northern New Jersey. Y-9932.

Field Engineer, civil graduate, with highway, street and municipal engineering experience for field and office work with contractor. Salary, \$5,200–\$6,500 a year. Location, Philadelphia, Pa. Y-9954.

Engineers. (*a*) Road Inspector for state highway department on highway and bridge construction. Salary, \$3,572 a year. (*b*) Junior Assistant Highway Engineers, grades I and II, same work as above. Salary, grade I, \$4,769; grade II, \$4,013. Car or living allowances while away from established residence. Location, middle eastern state. W-64.

Highway Engineer. 30–40, at least 10 years' highway experience, including responsible charge in important positions for at least 3 years. Must be able to write clear reports and to make effective oral presentations to both technical and lay groups. Position requires some traveling. Headquarters in eastern city. W-107.

Junior Engineers. Civil, mechanical, ceramic or mining graduates, for training program in cement industry, both sales and plant engineering. Locations, New York, N. Y., Pennsylvania and Midwest. W-198.

Construction Engineer. 30–35, who has had some experience laying pipe lines, preferably cast iron. The job would entail considerable traveling, supervising the installation of the company's product. Salary, to \$10,000 a year. Location, East. W-229.

Research Engineer. 35–45; civil engineering graduate, who majored in structural design; master's degree desirable. Experienced in the theory and design of structural steel; ability to write technical reports and lead discussions. Must have the ability to speak informally at meetings. Design experience in the use of reinforced concrete and other structural materials. Location, New York, N. Y. W-312.

Engineers. (*a*) Designer, graduate civil engineer, with minimum of 3 to 5 years' experience in highway bridge design. This experience is essential. Salary, \$7,020–\$7,800 a year. (*b*) Highway Bridge Draftsman, with from 1 to 3 years' experience on this type of work. Salary open. Location, Connecticut. W-318.

Instructor. B.S. or M.S. in civil engineering, to teach surveying, stress analysis and other civil engineering subjects. Salary, for 9 months, \$3,800–\$4,000, depending on qualifications. Location, Midwest. W-329.

Junior Engineers. Civil, mechanical or electrical graduates, for inspection and field engineering covering process equipment installation. Must be citizens. Salary, \$4,800–\$5,400 a year. Location, southern Nevada. W-339.

Field Editor for national business publication in the civil engineering construction field. Engineering training, construction experience and writing aptitude essential. Will take own photographs. Salary open. Headquarters, East; must be willing to travel. W-350.

Structural Engineer. To 35, civil graduate, with some prior experience in design and stress analysis. Will compute stress and strain problems on steel joists, trusses, etc. and prepare layout and detail drawings for shop fabrication. About 60 percent board work required. Will consider recent graduate or part-time employment in same field. Salary, to \$5,400 a year to start. Location, Detroit, Michigan. D-9500.

Civil Engineer. Under 30, registered in the State of Michigan, to make land surveys, plot maps, make office computations and prepare reports. Salary open. Location, Detroit, Michigan. D-9505.

Field Engineer. Civil graduate, with knowledge and experience in structural design and concrete construction. Should be qualified to meet and deal with contractors and act as consultant on problems involving concrete. Some travel. Salary open. Location, Midwest. D-9506.

New Publications

(*Continued from page 113*)

that, "The way to make this forward step has been pioneered by the Building Research Advisory Board. The way to make it practical and industry-wide is through membership in the Building Research Institute." Inquiries should be sent to the Construction and Civic Development Department of the Chamber of Commerce, Washington, D.C.

Highway Laws. Modernization of state highway laws is urged in Bulletin 88 of the Highway Research Board, entitled *Better Laws for Better Highways*. The first of a series of monographs dealing with the subject, Bulletin 88 provides a history of the highway laws project (instituted by the Board's Highway Laws Committee), and indicates the direction of future activities. Inquiries about the publication, which sells for 45 cents, should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Bibliography. Bulletins and publications of the Iowa Engineering Experiment Station from 1900 to 1954 are listed in the Station's Engineering Report 20, which was issued as the May number of the *Iowa State College Bulletin*. Free copies of the report are available from Iowa State College, Ames, Iowa.

Engineering Materials. Previously issued, new, and forthcoming books on engineering materials, published or planned for publication by the American Society for Testing Materials, are described in a recent ASTM List of Publications. Standards, Symposiums, Indexes, and Proceedings, with prices for each, are included. Inquiries should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

Tidal Hydraulics. Recommendations for study and research programs aimed at solving the engineering problems associated with tidal phenomena are listed in a *Bibliography on Tidal Hydraulics* prepared by the Research Center at the Waterways Experiment Station and released by the Corps of Engineers. Identified as Report No. 2 of the Committee on Tidal Hydraulics, the bibliography may be obtained from the Philadelphia District of the Corps of Engineers, P.O. Box 8629, Philadelphia 1, Pa.

Topographic Mapping. Availability of the most recent index maps showing the status of topographic mapping in the United States is announced by the U.S. Geological Survey. Requests for copies should be made to J. O. Kilmartin, Chief, Map Information Office, U.S. Geological Survey, Washington 25, D.C.

Welding Aluminum. Latest developments in the science of welding aluminum are described by the Aluminum Company of America in a new 176-page publication entitled *Welding Alcoa Aluminum*. Photographs and drawings aid in giving a comprehensive summary of all the practical welding methods, including inert-gas shielded arc welding, resistance welding, and pressure welding. Free copies are available from the Aluminum Company of America, 733 Alcoa Building, Pittsburgh 19, Pa.

Highway Conference. Proceedings of the 1954 California Street and Highway Conference are on sale by the University of California Press, Berkeley 4, Calif., at $2. The 159-page illustrated publication contains 43 papers and panel discussions under six general headings: Highway law; economics; planning and standardizing; urban transportation; traffic and safety; and engineering, construction, maintenance. The conference is sponsored annually by the university's Institute of Transportation and Traffic Engineering.

Drafting Practice. Draft copies of Section 13 (Springs, Helical and Flat) of the proposed American Drafting Standards Manual are being distributed to industry for comment. Copies are available from D. M. Shackelford, Standards Administrator, the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

Highway Officials. A new directory of state highway personnel, brought up to June 1954, is now available from the American Road Builders' Association (World Center Building, Washington 6, D.C.), at $1 a copy. The vest-pocket directory includes more than 1,500 names, titles, and addresses of administrative engineers and officials in the 48 state highway departments and the District of Columbia; administrative and engineering personnel of the ARBA, the Bureau of Public Roads, and toll road authorities; a tabulation of 1953 highway expenditures by state; and a tabulation of states having legislative authority to construct toll roads.

Dam Design. Design criteria for concrete gravity and arch dams are described in the Bureau of Reclamation's recently published Monograph No. 19, written by F. D. Kirn. Copies may be obtained from the Technical Information Branch of the Bureau of Reclamation, Denver Federal Center, Denver 2, Colo.

Pollution Control. A revision of the *Digest of Sewerage Enabling Acts of the State of California*—released three years ago by the California State Water Pollution Control Board to aid individuals and communities in solving their local waste-disposal problems—is now available. The present edition includes legislative amendments enacted since 1951; a condensed table comparing the various types of sewerage districts; tables outlining procedures for forming and financing five types of districts; and a state-wide listing of six types of districts now providing sewerage services. Single copies of the revised digest may be obtained from the State Water Pollution Control Board, 721 Capital Avenue, Sacramento 14. Additional copies may be purchased from the Documents Section, State Printing Division, 11th and O Streets, Sacramento 14, at 50 cents each, $4 for ten copies, or $7 for twenty copies (persons living in California add the 3 percent sales tax).

Bridge Design. Comparative studies of welded and riveted bridges, showing how welded designs can save time, material, and money, make up a 211-page publication of the James F. Lincoln Arc Welding Foundation. The material consists of designs entered in the company's recent design award program. Copies in cloth-covered

Annual Convention of ASCE

Hotel Statler, New York, N.Y., Oct. 18-22, 1954

(Please print)

Name..

Street..

City............................ Zone........ State........................

Mail to:

Mr. ALBERT G. COX, Assistant Sales Manager
Hotel Statler, Seventh Ave. & 32nd St., New York, N. Y.

Please reserve for my occupancy the following hotel accommodations:

Double.............................. Single..............................

Double-Twin beds.................. Suite..............................

Other..

Date and hour of arrival..

Date of departure..

board sell for $2 in the United States and $2.50 elsewhere. Orders should be sent to the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

Construction Estimating. Up-to-the-minute estimating and cost data on all classes of building construction are given in the new twelfth edition of *The Building Estimator's Reference Book*, a 1755-page compendium published by the Frank R. Walker Company, 173 West Madison Street, Chicago 2, Ill. The selling price of $12 includes a handy 220-page *Vest-Pocket Estimator* for use on the job. Designed to speed up estimating and insure accuracy, the publications consider the needs of contractors on both large and small jobs. *The Vest-Pocket Estimator* is not sold separately.

Concrete Pavement. Concrete is presented as meeting all the requirements of durability and economy for paving parking areas in a Portland Cement Association brochure entitled *Concrete Pavement for Parking Areas*. The publication consists essentially of a design study based on well known formulas, experience from pavements in actual service, and tests of full-scale concrete slabs. Pavement cross sections and design details are recommended for all typs of parking areas under average conditions. Suggested specifications to govern construction are also given. Inquiries should be sent to the Portland Cement Association, 33 W. Grand Avenue, Chicago 10, Ill.

Advance Registration for Annual Convention of ASCE

To:

PROF. J. M. GARRELTS
General Chairman
Annual Convention Committee, ASCE
33 W. 39th St., New York, N. Y.

It is my plan to attend the Annual Convention. I shall have ..... guests attending with me.

Please reserve for my use the following tickets, which I shall pick up when I arrive and register:

FUNCTION	NO. OF TICKETS
Monday, Oct. 18	
Employers-Employees Lunch	....
Kickoff Party	....
Tuesday, Oct. 19	
St. Lawrence Seaway Lunch	....
Sanitary Engineering Dinner	....
Wednesday, Oct. 20	
Membership Lunch	....
Thursday, Oct. 21	
Highway Planning Lunch	....
Smoker	....
Friday, Oct. 22	
Harbor Tour	....
City Planning Lunch (Easton, Pa.)	

For the Dinner-Dance on Wednesday, October 20, please reserve:

.... tables seating 10 each.
.... tickets

For which find enclosed my check covering the cost, and a list of the persons to be seated. Per plate $10.00.

RECENT BOOKS

Calculation Design and Testing of Reinforced Concrete

Fundamentals of theory, testing, and design of reinforced concrete are covered in three sections dealing with general theory, experiments, and simple designs of common structures. The book, by K. L. Rao, is intended for students preparing for examinations for a first degree or for professional society examinations. (Sir Isaac Pitman & Sons, Ltd., London, second edition, 1953. 424 pp., 35s.)

Elementary Fluid Mechanics

Fundamentals, physical properties, and fluid statics are discussed first, and then follows a chapter on one-dimensional flow presented as background for general treatment of fluid flow problems. Incompressible ideal fluid flow and the impulse-momentum principle are similarly considered, as important tools for future use. The discussion of basic facts of flow of a real fluid leads to flow in open pipes and channels, and fluid measurements are dealt with. A chapter on flow about immersed objects concludes this edition which has been critically reviewed and revised. John K. Vennard is the author. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., third edition, 1954. 401 pp., \$5.50.)

Engineering Contracts and Specifications

Legal and business aspects of the engineering profession are presented in this book by Robert W. Abbett which has been revised and expanded throughout. Material on contracts, specifications and the presentation of legal rights and obligations in construction work has been considerably amplified, and other sections have been rewritten in the light of current professional practice. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1954. 429 pp., \$6.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

Engineering Mechanics

Fundamentals are presented in a manner that shows how they may be applied to practical engineering problems. As in the previous edition, both analytic and graphic methods are used, and equations have been interpreted in terms of their geometrical equivalents. The complete text has been rewritten by Ferdinand L. Singer, with some discussions expanded and others simplified. Summaries at the end of each chapter aim to make the text useful for a review of the subject in post-college work. (Harper & Brothers, 49 East 33d St., New York 16, N.Y., second edition, 1954. 525 pp., \$6.)

(*Continued on page 121*)

Non-ASCE Meetings

American Concrete Pipe Association. The Association's fourth annual short course school of instruction will be held at the Statler Hotel, St. Louis, Mo., October 25–27. Exhibits of equipment used in the concrete pipe industry will be a feature. Details are available from the American Concrete Pipe Association, 228 North La Salle St., Chicago 1, Ill.

American Institute of Chemical Engineers. Meeting at the Colorado Hotel, Glenwood Springs, Colo., September 12–16.

American Institute of Electrical Engineers. Fall general meeting at the Morrison Hotel, Chicago, Ill., October 11–15.

American Institute of Steel Construction. Thirty-second annual convention at the Greenbrier, White Sulphur Springs, W. Va., October 25–28. Further information from the American Institute of Steel Construction, 101 Park Ave., New York, N. Y.

American Public Works Association. Public Works Congress and Equipment Show at the Municipal Auditorium, Atlantic City, N.J., September 19–22. Information from the American Public Works Association, 1313 East 60th St., Chicago 37, Ill., for more detailed information.

American Road Builders' Association. Second Annual National Highway Conference of County Engineers and Officials at the Deshler Hilton Hotel, Columbus, Ohio, September 13–15. For reservations write to Walter T. Jacobs, Chairman of Housing Committee, Ohio County Engineers Association, 970 Dublin Road, Columbus 8, Ohio.

American Society of Planning Officials. 1954 National Planning Conference at the Benjamin Franklin Hotel, Philadelphia, September 26–30. Details from the American Society of Planning Officials, 1313 East 60th St., Chicago 37, Ill.

American Welding Society. National fall meeting at the Sherman Hotel, Chicago, Ill., November 1–5. The National Metals Exposition will run concurrently at the International Amphitheater, Chicago. Further information from the American Welding Society, 33 West 39th St., New York 18, N.Y.

Chi Epsilon. Meeting of the New York Alumni Chapter in the Engineering Societies Building, Room 1101, October 6, 7:30 p.m., preceded by an informal dinner (at 6 p.m.) in the New York Times Dining Room, 11th floor, 229 West 43rd St.

Society of Automotive Engineers. National tractor meeting and production forum at the Hotel Schroeder, Milwaukee, Wis., September 13–16.

(Continued on page 120)

Non-ASCE Meetings

(Continued from page 119)

Society for Experimental Stress Analysis. Annual meeting and exhibition to be held in conjunction with the First International Instrument Congress & Exposition at the Bellevue-Stratford Hotel, Philadelphia, Pa., September 21–23. Further information from General Chairman Frank G. Tatnall, P.O. Box 4034, Chestnut Hill, Philadelphia 18, Pa., or Exhibits Chairman Greer Ellis, c/o Ellis Associates, P.O. Box 77, Pelham 65, N.Y.

Southeastern Association of State Highway Officials. Annual meeting at the Andrew Jackson Hotel, Nashville, Tenn., September 28–30.

Applications for Admission to ASCE, July 17–August 7

Applying for Member

John A. Becker, Ontario, Canada.
Earl DeWeese Bristow, North Augusta, S.C.
Earl Stanley Fenelon, Pittsburgh, Pa.
John Edward Hoff, Houston, Tex.
Harry Joseph Keefe, Boston, Mass.
Frank Wilson Kiefner, St. Louis, Mo.
Aksel August Latvala, Kansas City, Mo.
Cornelius Hickman List, Rogersville, Tenn.
Thaddeus James Montgomery, Cincinnati, Ohio.
Kwan Doo Park, Cambridge, Mass.
Muhammad Lutfur Rahman, Houghton, Mich.
Carroll Arthur Reese, Spartanburg, S.C.
Thomas Jefferson Sowers, Kansas City, Mo.
William Condit Stevens, New York, N.Y.
Arthur Harold Stone, Chicago, Ill.
John Masato Tanimura, Honolulu, Hawaii.
Alton Duane Taylor, Buffalo, N.Y.
William Harold Taylor, Mobile, Ala.
David Gregory Volkert, Mobile, Ala.

Applying for Associate Member

John Bennett Adams, East Greenwich, R.I.
Ernest Laslow Balint, Miami, Fla.
William Howard Baugh, San Francisco, Calif.
Richard Alfred Carr, New York, N.Y.
William Tysdale Docherty, Dunbartonshire, Scotland.
Earl Francis Dunkle, Kansas City, Mo.
Theopanis Gofas, Athens, Greece.
Paul Franklin Graham, Columbus, Ohio.
John Alfred Gustafson, Denver, Colo.
Robert Morphet Haythornthwaite, Providence, R.I.
Isaac Lombana, Caracas, Venezuela.
Joseph Laurence McParlan, New York, N.Y.
Basaral Srikantiah Nagaraj, Bihar, India.
Robert Bernard Pechner, San Francisco, Calif.
Lawrence Kenneth Peterson, Sacramento, Calif.
Richard Wesley Riedel, Freeport, Tex.
James Dugan Shell, Jackson, Miss.
George Albion Smith, Hobart, Ind.
James L. Spalding, Louisville, Ky.
Milton Louis Speckels, China Lake, Calif.
Gerald Taylor, Brussels, Belgium.

Applying for Junior Member

Noel Ralph Adams, Seattle, Wash.
Luther Newell Amos, Jr., Harrisburg, Pa.
Lucian Ben Bogran, Yoro, Honduras, C.A.
Romola A. Corcuera, Ann Arbor, Mich.
Suha Sirra Eren, Ankara, Turkey.
Josue Gutierrez-Villegas, Colombia, S.A.
Robert Edwin Mellard, Charleston, S.C.
James Roger Miller, Annapolis, Md.
Barry Neil Norris, Milwaukee, Wis.
Homer Perry, Richmond, Va.
Carl Johan Romhild, Cambridge, Mass.
Robert Arthur Snowber, New York, N.Y.
Charles Andrew Van Sickle, New York, N.Y.
Urs Christian Widmer, San Francisco, Calif.
Kenneth Vanburen Wilson, Jackson, Miss.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

Recent Books

(*Continued from page 118*)

Engineering for Agricultural Drainage

Engineers, agriculturists, and others concerned with the conditioning of land for the production of cultivated crops will find this book of interest. Soil and soil-moisture characteristics and behavior, crop characteristics, and irrigation as related to drainage are stressed in recording the latest developments in the design and construction of open ditches and underdrains, and in dealing with such problems as moisture control on peat and muck lands, selection of drain tiles, drainage costs, and legal considerations. There are appendices covering the unit hydrograph method of determining run-off and the design of permeameters, and a list of references is included. Harry Burgess Roe and Quincy Claude Ayres are the co-authors. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., 1954. 501 pp., $7.50.)

Execution du Beton Precontraint

The author, Louis Bourgine, presents a practical treatment of prestressed concrete which gives design details, descriptions of construction methods and information on the use of available materials, discusses the choice of construction methods, and deals with cost estimates. The illustrations materially increase the value of the book. (Editions Eyrolles, Paris, 1954. 113 pp., Ffrs. 1350.00.)

The Flood Control Controversy

An examination of the controversial aspects of flood control in terms of the technical problems involved by Luna B. Leopold and Thomas Maddock, Jr. Starting with the ascertained facts in the hydrology of rivers and floods, the authors show the possibilities and limitations both of engineering structures and land management. They present a critical review of the effectiveness of upstream and downstream programs as advocated respectively by the Department of Agriculture and the Corps of Engineers. (Ronald Press Co., 15 East 26th St., New York 10, N.Y., 1954. 278 pp., $5.)

Famous Subways and Tunnels of the World

While written for younger readers, the assembled facts and the incidents in this book by Edward and Muriel White may be of interest to civil engineers. Drawings and photographic reproductions, showing tunnels and subways under construction, add to the value of the book. (Random House, 457 Madison Ave., New York 22, N.Y., 1953. 97 pp., $1.75.)

Hydraulics Refresher for Professional Engineers License

John D. Constance presents here a comprehensive selection of examination questions, with worked-out solutions, dealing with hydrostatics and hydrodynamics; circular orifices, weirs, pipe flow, and open channels; pumps and turbines; Reynold's number, mechanism of fluid-flow, etc. Brief text review material precedes the illustrative problems in each case. The book is intended to be useful for practical engineering work as well as for examination review. (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J., first edition, 1954. Various pagings, $2.75.)

Introduction to Nuclear Engineering

Intended for the junior or senior engineering student, this textbook, by Raymond L. Murray surveys the field of atomic energy and discusses some typical engineering problems. It deals with the nuclear reactor, nuclear fuels, handling radioactive materials, instruments for detection and control, and related subjects. In addition, there are chapters on the uses of isotopes, nuclear propulsion, and on electric power plants using nuclear fuel. (Prentice-Hall, Inc., 70 Fifth Ave., New York, N.Y., 1954. 418 pp., $9.35.)

Prestressed Concrete Design and Construction

This reference book for practicing engineers and engineering students discusses principles of prestressing (uniform, non-uniform, post and pretensioning) and their application to the design of various structural members. There are chapters on materials and allowable stresses, on losses in prestressing, and on practical methods of prestressing. Appendixes give data for the rapid selection of suitable sections and for determining the position of pre-tensioning wires. F. Walley is the author. (Published for the Ministry of Works by H. M. S. O., York House, Kingsway, London, W.C.2, 1953. 279 pp., £1 10s. od.)

The Steel Skeleton

Volume I: Elastic Behaviour and Design

Largely a report of investigations made for the Steel Structures Research Committee (Great Britain) from 1929 to 1939, with some references to later work bearing directly on the subject. There are chapters on tests made of experimental frames, hotel, office, and residential buildings; on stresses and loadings of beams and columns; and on a design method developed by the Committee. An appendix discusses design of bomb-resistant frame structures. The volume has been prepared by J. F. Baker. (Cambridge University Press, 32 East 57th St., New York 22, N.Y., 1954. 206 pp. $8.50.)

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Pavement Cutting Machine

A NEW MACHINE for cutting pavement has just been manufactured. Powered by a 26.8 hp motor for fast cutting, this machine features Windsor diamond blades in diameter sizes of 12 to 22 in., which are long wearing because they have been developed with new bonds and offer guaranteed concentrations. A cooling and flushing system has been designed to remove all loose abrasives in the cut.

Windsor Concrete Cutter

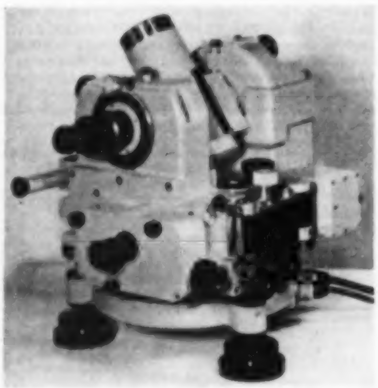
This is accomplished by water being carried down to both sides of the blade by twin steel tubes where it is jetted into the blade collar. Through centrifugal action, the water is then picked up and forced through slanted holes, spaced at $^1/_4$ in intervals, onto the blade and into the cut. Other features of the Windsor concrete cutter are depth of cut control, durable welded metal frame, heavy duty front shaft that permits fast cutting, hydraulic system, which balances the machine's 1000 lb weight for easy maneuverability, heavy duty semi-pneumatic tires, 6-volt self-starting battery and a front pointer or guide which automatically maintains cutting position. **Windsor Machinery Corp., CE 9-122, 61 Airport Road, Hartford, Conn.**

Form Tie

THE ADDITION OF a breakback coating to the Symons panel ties and washer ties has been announced. This new coating reduces the bond between concrete and steel, making it easier to break the tie back an inch inside the wall. The increased use of air entraining agents and additives to concrete has intensified the need for this type of coating. Engineers and architects are becoming more and more particular about the quality of the concrete, which means drier mixes, more cement, more vibration and in turn a stronger bond between concrete and steel. Symons engineers have designed and built a machine which applies this anti-bond coating quickly and efficiently. **Symons Clamp & Mfg. Company, CE 9-122, 4249 Diversey Avenue, Chicago 39, Ill.**

Precision Theodolite

THE GIGAS PRECISION Theodolite is of compact, closed in design and embodies advantages which can be summed up as follows: photographing of both circles with Robot miniature camera utilizing standard 35 mm film and provided with automatic release and film transport, thus saving time and expense in completing a station, at the same time enhancing the accuracy of the observation; for first and second order triangulation; utilizing the instrument for flare triangulation essential in inaccessible areas or over water; for astronomical purposes as a universal instrument, such as determination of LaPlace points, measuring astronomical azimuths. The following data are obtained on each record: an image of that part of the azimuth and elevation circle which is in the field of view, the coincidence method being used for later evaluation; an image of the plate or alidade level free from parallax at the exact moment of observation; time indication at the moment the exposure was made; station identification by means of hand-written notation of the observed on the film. For evaluating the film, the theodolite micrometer is used which can easily be taken off and mounted in a

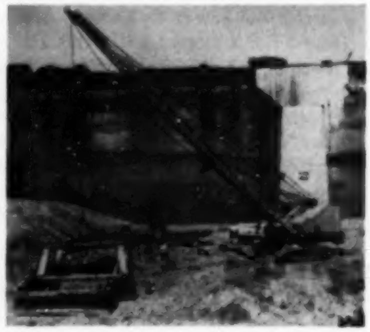


Gigas Theodolite

stand for facilitating the reading of the film. Optical data: broken telescope with three exchangeable eyepieces for 40, 63, and 80 power magnification; telescope focus 500 mm, free aperture 63 mm adjustable glass circles for azimuth and elevation, diameter 200 and 140 mm respectively; detachable optical micrometer, direct reading to 0.2 in.; automatic camera with spring drive for 48 exposures on standard 35 mm film. Simultaneous recording of the reading of both circles as well as photographing of cross level and clock. **Geo-Optic Company, Inc., CE 9-122, 170 Broadway, New York 38, N. Y.**

New Excavator

PRODUCTION OF A new excavator, the model 405, in the 20 ton lift capacity class has been announced. It has only two major shafts in the upper machinery which are used for all applications. Crawler-mounted, the 405 is now available with five attachments. The shovel and hoe are designed for buckets of one cu yd capacity. Digging depth of the hoe is $22^1/_2$ ft; width of hoe dipper is three



Model 405

ft seven in. over sidecutters. As a lift crane, the 405 handles up to 20 tons. Swing speed is 3.62 rpm, travel speed is .80 mph. The excavator travels with ease on grades up to 30 per cent, and is designed for use with gasoline, diesel, or electric power. Features built into this modern excavator include: self-cleaning crawlers; all welded booms; mechanical swing clutches; removable grooved metal drum lagging and automatic traction brakes. **Koehring Company Sales Office CE 9-122, 3026 W. Concordia Ave., Milwaukee 16, Wis.**

Short Haul Conveyor

A NEW, STANDARDIZED, belt conveyor for "short haul" requirements, has been announced. Units of the new series are called "Transfer Conveyors." Standardized components may be assembled to form conveyors ranging from 8 to 44 feet in length, in increments of 1 foot. Mounted on a 5 inch channel frame, the "Transfer Conveyor" is available in 18, 24 and 30 inch belt widths and in lengths as already specified. Units up to 20 feet in length are shipped, completely factory assembled, except for carriers and belt. Electric power units; crowned steel head and tail pulleys, ball bearing mounted; 4 inch diameter ball bearing Barber-Greene troughing carriers and full Alemite lubrication are among the features offered. Capacities range from 50 to 480 tons per hour depending upon belt width and weight of material being handled. Send for catalog. **Barber-Greene Company, CE 9-122, 400 No. Highland Ave., Aurora, Ill.**

Equipment, Materials & Methods (Continued)

Trojan Loadster

A NEW $^3/_4$ cu. in. struck measure loader has recently been put on the market. This machine, known as the Model LH-75 Trojan Loadster, embodies a new idea in loader design—elimination of all clutches. This in turn eliminates clutch wear. It has a direct drive from the engine, through a torque converter coupling to the transmission. Five working speeds are provided, including a high speed range for traveling; each speed has full forward and reverse travel. The directional shifting lever is conveniently located just below the steering wheel. It loads over the drive wheels, and the load weight is used to provide extra traction. All these features produce a powerful surging crowd. **Contractors Machinery Co., CE 9-123, P. O. Box 191, Batavia, N. Y.**

Earthmover Tire

A LOW-PRESSURE, earthmover-type tire of new design is being developed to permit improved performance by vehicles on large earthmoving projects. Known as the Wide Base Earth Mover, the new tire is made in two sizes, 29.5 × 25, and 29.5 × 29, replacing the company's 25 and 29 sizes. It is available in both the Earth Mover Sure Grip and Hard Rock Lug tread designs. Although the new tire is priced slightly higher than the corresponding $24.00 sizes, actual cost per yard for hauling material on the wider base tire should be less, reports indicate. The wider base gives the tire superior flotation, thus permitting faster, steadier operation of the vehicle. **Goodyear Tire & Rubber Company, CE 9-123, Akron 16, Ohio**

Wide Base Earth Mover Tire

Dipper Trip

THE ADDITION of an electrically operated shovel dipped trip as optional equipment on the Shield Batam line of truck and crawler-mounted $^3/_8$ cu yd power shovels has been announced. Operating speed and efficiency are increased with the new trip attachment by enabling the operator to swing and dump without changing controls. A thumb-operated push-button switch is mounted on the swing clutch lever, which activates an electric motor mounted on the shovel boom. The motor, in turn, winds up a dipper chain, which trips the bucket dipper. **Schield Bantam Company, CE 9-123, Waverly, Iowa**

Equipment, Materials & Methods (Continued)

Portable Electric Melting Pot

A PORTABLE ELECTRIC melting pot for melting asphalts, tars, pitches, resins, mastics, and other viscous materials has been introduced. The unit is both light and small (12 in. × 14 in. . . 15 lb). Its portability makes it especially suitable for repair jobs where only small amounts of material need be melted. The melter,

Glas-Col Melting Pot

which easily fits into the trunk of any passenger car, eliminates the need for handling large, heavy and unwieldy production type melters. It has a working capacity of $3\frac{1}{2}$ gallons and operates from any 115 volt, 60 cycle outlet (1250 watts). Heating chamber insulation is of $1\frac{1}{4}$ in. thick Fiberglas . . . efficiency is more than 80%. Heating elements are of Nichrome wire, and the unit's housing is of 20 gauge aluminum. The Glas-Col portable electric melting pot is priced at $75. **Glas-Col Apparatus Co., Inc., CE 9-124, 711 Hulman St., Terre Haute, Indiana.**

Largest Ditcher

THE LARGEST DITCHING machine in the world, capable of digging a ditch 15 ft wide and 30 ft deep, has been designed. Called the Gar Wood Buckeye Model 435, it will be used to excavate intercepting and outfall sewer trenches, water diversion aqueducts and other large ditches. Overall approximate dimensions of the new ditcher are: length 81 ft; height 15 ft; width 12 ft; excluding the dirt discharge conveyor. It's estimated weight will be 65 tons. The machine will be crawler mounted at the digging end and supported by rubber tired wheels in front. Two diesel engines with torque converters will supply power to the crawlers and the digging drive. Hydraulic power steering will be another feature. **Gar Wood Industries, CE 9-124, Wayne, Mich.**

Equipment, Materials & Methods (Continued)

Remote-Controlled Jack

A 50 TON remote-controlled hydraulic jack has been placed on the market. Consisting of a hydraulic ram and a high-pressure connecting hose and pump, the jack can be used in confined quarters under loads with minimum clearance, and in other locations where the additional safety and convenience of remote operation is desirable. It is valuable for use as a hydraulic press and for lifting and lowering heavy machinery, lifting and aligning beams, and straightening equipment. The ram has a minimum height of $10^1/_2$ inches and a $5^1/_2$ in. lift.

50 Ton Hydraulic Jack

For faster operation, the pump has an automatic switch-over which permits rapid positioning of the unloaded ram and low speed, powerful pumping when the ram lifts the load. A safety by-pass valve prevents over-loading. **Templeton, Kenly & Co., CE 9-125 2523 Gardner Road, Broadview, Ill.**

Rubber Road Paving Pellets

TINY PELLETS MADE of synthetic rubber may speed the wide spread use of rubber roads. Tossed into a mixing mill at an asphalt plant, they break down in 60 seconds, spreading rubber evenly through the mix. Rubber-asphalt is used for the top layer on a road. A one and a half in. coating forms an "umbrella" over the bulk of the paving material, preventing water from seeping down to the lower layers and causing cracks, pot holes or ruts. This topping increases the load-carrying capacity of the road and improves skid resistance by preventing asphalt oil from rising to the surface and causing a slick coating after a light rain. The rubber also improves the bond between the asphalt and stone aggregate. From 6 to 12 lb. of the pellets are added to a ton of asphalt, which covers 13 sq yd of road with a one and a half in. thick layer, giving a three to six per cent rubber content. **United States Rubber Co., CE 9-125, Rockefeller Center, New York 20, N. Y.**

Rubber Sheet Linings

ANNOUNCED IS THE addition of natural rubber sheet linings to supplement neoprene, saran rubber, polyethylene and plasticized polyvinyl chloride sheet and tank linings. In addition to being installed in lining shops, these linings are applied in the field by trained crews. **The Atlas Mineral Products Co., Mertztown, Penna. CE 9-125**

Equipment, Materials & Methods (Continued)

Instant Setting Cement

GARONITE, A HEAVY dense, grey cement which dries without shrinking to a mass of great strength has been developed as an anchoring medium for any type of machinery or concrete installation, including heavy-duty vibrating equipment. It may also be used for patching concrete floors, and other repairs of emergency nature demanding early use. Garonite is applied cold by adding water. The speed of setting permits use of machines in 30 minutes to one hour, depending upon size and weight. At one hour compression strength of the cement is guaranteed to exceed 5000 psi, increasing to more than 12,000 psi full strength. Advantages of Garonite include savings in time, labor, cost of material, and replacement of anchors due to excessive vibration and strain of heavy equipment. An absolute shrink-proof union between bolt and base assures permanent, trouble-free anchorage for any type of installation. **The Garon Products Co., CE 9-126, 37 South 13th St., Philadelphia 7, Penna.**

Dual Expansion Anchor

A DUAL EXPANSION anchor called the Wyem Dual Expansion Anchor has been produced. They Wyem Anchors are universal in application to concrete, brick, hollow tile, cinder block, marble, plastics, glass, wood, metal and similar materials. They are used in industrial, commercial and domestic fields. They are simple to install, save time and money and no setting is required. Safe, secure and rustproof they will resist corrosion, withstand shock and vibration. Wyem Anchors will not slip, lose their grip, or shear; can be used at any depth of hole and made to hold at any point, even where hole is drilled too wide or deep. Obtainable in all sizes to fit standard machine screws, they will not distort and can be used over again. They can be used in place of toggle bolts, and round head of flat head machine screws can be used with Wyem Anchors. **Wyem Products Co. Inc., CE 9-126, 2292 South Taylor Rd., Cleveland 18, Ohio.**

Drafting Tape

A NEW DRAFTING tape has just been introduced which should relieve some sticky problems for the whole league of workers who must use the drawing board or drafting table. Called Behr-Cat No. 114 Drafting Tape, it is now available to the industrial market in 60 yd rolls, boxed or bulk packed. There are 17 standard widths ranging from $^1/_4$ to 3 in. Because of its controlled adhesive qualities, the new tape will: hold tracing paper or cloth firmly on drafting or drawing boards; come off the roll cleanly; leave no defacing or discoloring marks on the drawing paper or cloth. **Behr-Manning Corp., CE 9-126, Troy, N. Y.**

Equipment, Materials & Methods (Continued)

New Type Wall Panels

PRECAST CONCRETE WALL panels, a new type of "clothing" for industrial buildings, saves both time and money in erection. These panels are like concrete sandwiches. Each consists of two layers of wire-reinforced concrete around a filling of insulation material—in this case, Fiberglass. The panels are five to eight in. thick and come in many basic sizes from eight by eight feet up. A special broomed exterior finish gives them the appearance of cut limestone. Precast wall panels can be erected in less than half the time it takes to erect conventional walls. The panels are tongue and groove in design. Horizontal seams are sealed with concrete. Metal inserts cast into the panels permit them to be bolted to the metal framework of the building. It is claimed that these panels cut costs anywhere from 25% to 33% in comparison with ordinary concrete or thick brick masonry. **The Marietta Concrete Corp., CE 9-127, Marietta, Ohio.**

Joist-Space-Heat-Tester

THE JOIST-SPACE-Heat-Tester, a new scientific apparatus for making comparative heat-flow tests of the various thermal insulations, is now being offered for two weeks' free use to members of the building industry interested in minimizing undesired heat loss in building structures in winter and heat gain in summer. It is simple to use; lightweight; portable; and consists of two similar, interchangeable units that fit together into one light carrying case, and contain two thermometers. This tester simulates actual joists and building spaces, and employs all three methods of heat-flow. Both insulations are exposed to heat-flow from the surface of a heated board. The insulations used may both be non-metallic, metallic, or one of each kind. The cost is $150,000 and included free will be sample insulations. To obtain the tester and samples write on business letterhead. **Infra Insulation, Inc., CE 9-127, 525 Broadway, New York 12, N. Y.**

Improved Membrane

RICHKRAFT 65, an improved membrane waterproofing paper, has been accepted by the F. H. A. as a water vapor barrier under concrete slab on the ground in place of felt or #55 membranes, and for over crawl space where the slab is not poured on the ground. It is made by laminating together two sheets of kraft paper pre-tested with a special fungicide. Two men can do approximately 14 houses of 1,000 sq ft each in eight hours, in comparison with three men required to do seven houses in the same time using #15 felt mopped together. Rolls come in sizes of 36 in. and 48 in. widths with 432 sq ft length, and 72 in., 84 in. and 96 in. widths with 1000 sq ft length. Available at distributors everywhere. **Richkraft Company, CE 9-127, Chicago, Ill.**

Equipment, Materials & Methods (Continued)

Impact Breaker

An entirely new concept for impact breaking of stone and minerals has been introduced. Called the Kennedy "Cuber Senior," the unit is a dual rotor, up-running impact breaker featuring a multistage, triple action reduction principle for both primary and secondary braking of non-abrasive stone and like material in a single unit. It is designed for both stationary and portable use in open or closed circuit operation. Regulated material flow is achieved with a low positioned feed device that provides a minimum feed height for maximum rock penetration and the elimination of "foul balls." In a split second after material enters the heavy duty Cuber Senior, while it is still falling, it encounters the rigidly mounted hammers of the first rotor in a head-on impact, receiving a good square blow of terrific force. At this very first point of concussion, the material is exploded along natural cleavage lines. The Kennedy multi-stage design incorporates more effective and versatile breaking facilities, with a greater ratio of reduction by free impact. Two massive rotors with integral hammers provide the entire rock breaking action, making it unnecessary to mount supplemental impact members close to the periphery of the hammers. The reduction chamber is large enough to permit free breaking of infed rock without restricting flow or jamming the breaking area. High capacity production of cubical material is accomplished at low cost with a lowered horsepower per ton requirement. **Kennedy-Van Saun Manufacturing & Engineering Corporation, CE 9-128 Beaver Street, Danville, Pa.**

Portable Testing Machine

CORRECTION—This new portable Testing Machine made by Soiltest, Inc. was reported in this column last month as a 20,000 lb tester. The correct capacity is 200,000 lb.

200,000 lb Testing Machine

Literature Available

Pozzolith—A four page folder describing the use of Low Heat Pozzolith in mass concrete for reducing total heat evolution has been published. It outlines advantages of Pozzolith in Plastic and hardened state, the various types and adaptation of Pozzolith, design of Pozzolith concrete, use in mass concrete, and use for structures and flat slabs in hot weather and in tropic and semi-tropic areas. Included are methods of use and comparison of Low Heat Pozzolith mixes with plain and air-entrained concrete mixes. Also contained in the folder are illustrations of mass concrete structures where low heat Pozzolith was used. **The Master Builders Co., CE 9-129, 7016 Euclid Ave., Cleveland 3, Ohio.**

Trusses—Longspan and standard trusses are the subject of a new four-page bulletin. The piece includes drawings of a variety of types of trusses as well as illustrations of buildings under construction involving trusses of these types: pitched; bowstring longspan; flat; cantilever and sawtooth. Copies of the bulletin may be obtained from **Pittsburgh-Des Moines Steel Company, CE 9-129, Nevill Island, Pittsburgh 25, Pa.**

Drills—A new bulletin outlines the diversified uses of the three Joy Challenger Drills, models TWM-2, TWM-2a and TWM-3. These drills may be employed for heavy construction jobs such as excavations, quarries, highways and open cut mines. The Challenger drills combine: fast drilling speeds resulting from the extra power of a 5¼ in. hammer drill; powerful blowing action and rotation; fast, easy setup through hydraulic control of the mast and levelling jacks; mobility to decrease time lost moving from hole to hole. Contained in the six page bulletin are informative charts and colored illustrations. Ask your Joy dealer for bulletin No. 87-U. **Joy Manufacturing Company, CE 9-129, Henry W. Oliver Bldg., Pittsburgh 22, Pa.**

Dall Flow Tube—A 16-page engineering bulletin on the new Dall Flow Tube has been issued. Technical Bulletin 115-L3 describes the new short differential producing metering device which has the lowest permanent loss of head of any known velocity-increasing differential producer. The bulletin includes information on: recovery characteristics, accuracy, applications, range, flow formula, laying length and working pressure of the device. Also included are sections on: installation, power consumption, effect of approach and downstream piping and fittings, and location of instruments. Tables and graphs are included in the bulletin to aid in the selection of the proper Dall Flow Tube and its secondary instruments. For copies of Technical Bulletin 115-L3, write **Builders-Providence, Inc., CE 9-129, 345 Harris Ave., Providence, R. I.**

Literature Available (Continued)

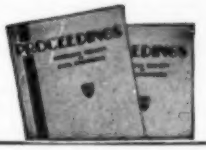
VALVES—Williams-Hager Flanged Silent Check Valves for the control of water hammer are the subject of a new four-page bulletin. In addition to technical descriptive data the bulletin includes a series of dimensional charts for valves of various sizes and pressure ratings. Copies of Bulletin No. 654 may be obtained from **The Williams Gauge Co., Inc., CE 9-130, 1620 Pennsylvania Avenue, Pittsburgh 33, Pa.**

INSTRUMENTATION—A new system of instrumentation for the measurement and/or control of liquids, is described in an eight page bulletin called "Pneumatic Operated Control". The bulletin illustrates the five basic principles used, its uses and applications in water and waste treatment plants, and the ease with which it can accomplish all the various types of process measurement and control. The booklet which includes complete specifications is available upon request. Write for bulletin No. 5421. Public Relations Department, **General Filter Company, CE 9-130, 525 Northwestern Bank Building, Minneapolis, Minn.**

THE GRATELITE STORY—An informative brochure of the Gratelite Louver Diffuser has been published. This eight page brochure gives complete details on the construction and performance of the sight-saving $^{1}/_{2}$ in. cubes. It also contains actual photographic installation of the world's largest Gratelite Louverall Ceiling. Many other very interesting lighting applications with complete engineering facts have also been incorporated in "The Gratelite Story". **The Edwin F. Guth Company, CE 9-130, 2617 Washington Blvd., St. Louis, Miss.**

WIRE ROPE—A new publication entitled "Wire Rope Recommendations and Catalog", designed to provide a simplified ordering plan and reference for wire rope users, has been issued. The catalog is divided into 16 sections, one for each of the major industries which use wire rope. Each section, clearly marked by index tabs for quick reference, gives detailed information on wire rope for specific requirements. The new catalog also includes photographs showing various wire rope applications in shipping, logging, construction, and mining. **John A. Roebling's Sons Corporation, CE 9-130, 640 South Broad Street, Trenton, N. J.**

VERSATILE SEWER STRUCTURES—The four important requirements for sewers are discussed in a new bulletin—easy handling, fast assembly, long life, and installed economy. The theme of the piece is that all sewer problems are different. How, where and when to choose the right type of sewer structure for the right purpose frequently puzzles city officials, engineers and contractors. This bulletin should help them. For a free copy write—**Armco Drainage & Metal Products, Inc., CE 9-130, Middletown, Ohio.**



PROCEEDINGS AVAILABLE

The following papers have become available as Proceedings-Separates. Following the date of issue of a paper, discussions thereof will be received for a period of three months, as specified on the cover of the paper. Titles will be added to this list every month, as they become available. Technical Division sponsorship is indicated by an abbreviation at the end of each item, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. Papers issued prior to, and including, Separate No. 289, were not distributed under the present automatic mailing system. If you have not registered in a Technical Division to receive its papers (one Division only) free of charge, please do so promptly by filling out and mailing the enrollment and subscription form (page 132) to Society Headquarters. For ordering separate papers, use the convenient order form on page 132.

Listed in Earlier Issues

445. Suction Force in Soils upon Freezing, by Alfreds R. Jumikis. (SM)

446. An Engineering Approach to Hot Cell Design, by H. M. Glen. (ST)

447. Shielding Structure Facilities for Atomic Energy Research, by Frank Ring, Jr. (ST)

448. An Approach to Hot Laboratory Design, by Gibson Morris. (ST)

449. Non-Uniform Torsion of Plate Girders, by Gerald G. Kubo, Bruce G. Johnston, and William J. Eney. (ST)

450. Continuous Deep Beams, by David H. Cheng and Ming-Lung Pei. (ST)

451. Behavior of Structures Subjected to a Forced Vibration, by Charles T. G. Looney. (ST)

452. Use of Delaware River Water Through the Delaware and Raritan Canal, by Howard W. Acken and Robert L. Hardman. (SA)

453. Recent Pennsylvania Experiences of Authority Sewage Works Financing, by Samuel I. Zack. (SA)

454. New York's Extension of Its Sources to the Delaware, by Karl R. Kennison. (SA)

455. Effect of Cabin Cruiser Waste Discharge on a Small Harbor, by William T. Ingram and Alexander Diachishin. (SA)

456. Sand Drain Applications by the Port of New York Authority, by John M. Kyle and Martin S. Kapp. (SM)

July

457. Planning and Engineering of U.S. Air Force Bases, by Lee B. Washbourne. (AT)

458. Airfield Pavement Design of the Corps of Engineers, by Gayle McFadden. (AT)

459. Discussion of Proceedings-Separates 163, 191, and 196. (AT)

460. Drainage in the Humid Areas of the United States, by John G. Sutton. (IR)

461. Diversion of Canals, by Hassan M. Ismail. (IR)

462. Factors Influencing Irrigation in Humid Areas, by Tyler H. Quackenbush. (IR)

463. Discussion of Proceedings-Separates 319, 347, 369, and 404. (IR)

464. Prospective Sites for Large Steam Plants, by Norman F. Williams. (PO)

465. Discussion of PROCEEDINGS-SEPARATES 273 and 294. (PO)

August

466. Flow in Open Channels, by Edward F. Wilsey. (HY) In the paper the Chezy formula is derived in a dimensional form; the alternate stages of flow are analyzed to illustrate the division of open-channel flow into two categories. The author has developed the dimensional equation for open channels on the basis of experimental data and has introduced the stream function as a possible explanation for the entrainment of air in steep chutes. A formula is developed for the velocity of flow in channels set at a gradual slope.

467. Tranquil Flow Through Open-Channel Constrictions, by Carl E. Kindsvater and Rolland W. Carter. (HY) Investigations of obstructions in bridge waterways have ignored the fact that the waterway itself is an example of a width constriction in the river channel. The paper describes basic research in which the bridge waterway is studied. A practicable solution of the discharge equation has been achieved by the application of a systematic experimental investigation to an approximate analysis. Empirical data, which extend the solution, are presented in dimensionless, graphical form. A significant feature is a detailed description of the external and internal characteristics of the flow pattern.

468. Safety and the Probability of Structural Failure, by A. M. Freudenthal. (ST) The applied loading and the probabilities of unserviceability and failure in relation to structural analysis are analysed. These two aspects are as important as the stress analysis; only from a complete structural analysis can rational estimates of the safety factors be obtained. Procedures are outlined for the numerical evaluation of factors of safety based on the expected variation of loadings and strength properties of the structural materials. The economic aspects of the problem are also cited.

469. Fatigue in Riveted and Bolted Single Lap Joints, by J. W. Carter, K. H. Lenzen, and L. T. Wyly. (ST) A working hypothesis is offered to explain the causes of and remedies for fatigue failures in structural joints; supporting evidence is included. A

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep a record of Separates you have received to avoid unwanted duplication.

2. Every ASCE member registered in one of the Technical Divisions will receive free, automatically, all papers sponsored by that Division. **Such registration will be effective the first of the month following the receipt of the registration form.**

3. Members' accounts will be charged at 25¢ each for every paper ordered specially.

4. Non-members of the Society may order copies of Proceedings papers by letter with remittance of 50¢ per copy, members of Student Chapters, 25¢ per copy.

Standing orders for all Separates in any calendar year may be entered at the following annual rates: Members of ASCE, $12.00; members of Student Chapters, $12.00; non-members, $20.00, plus foreign postage charge of $0.75; libraries, $10.00.

TRANSACTIONS. Specially selected PROCEEDINGS papers with discussions will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Morocco-grained binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

correlation of fatigue-test results on double-lap joints is made. It is shown that these results can be explained by the hypothesis. Also included are the results of a static test of a full-size structural joint connected by high-strength bolts.

470. Comparative Behavior of Bolted and Riveted Joints, by Frank Baron and Edward W. Larson, Jr. (ST) A comparison is made of the respective behaviors of bolted and riveted joints subjected to static and fatigue loads and is based on tests of butt joints fastened by hot-driven rivets, cold-driven rivets, and high-strength bolts. It was found that the clamping force of the fastener was one of the most important factors affecting the fatigue strength of the joint and that the fatigue strengths of the bolted joints were greater than those for the riveted joints. For static loads, the plate efficiencies were approximately the same, irrespective of the type of fastener.

471. Incineration and Alternative Refuse Disposal Processes, by Ralph Stone and F. R. Bowerman. (SA) Various refuse-disposal systems are evaluated, and the esthetic, sanitary, and economic factors involved are analyzed. Incineration as a refuse-treatment method is discussed—historically, economically, and technically. The authors summarize results from a number of refuse-disposal studies to aid in comparing the relative merits of alternative refuse-disposal systems; they present data on surveys and studies of existing incinerator installations. A report on field tests of incineration for optimum volume reduction is described. The thermodynamic and other considerations of incinerator design and operation are reviewed.

472. Infiltration Galleries, by Ralph Stone. (SA) The various factors in infiltration-gallery construction and operation are reviewed. The important factors include ground-water hydrology, water quality and treatment, aquifer permeability, costs, and hydraulics. Also included are the experiences of several communities with infiltration-gallery water works. It is concluded that a well-purified, dependable, low-cost water supply can be provided by infiltration galleries.

473. Refuse Collection: Report of a Subcommittee of the Committee on Refuse Collection and Disposal of the Sanitary Engineering Division. (SA) Far too many municipalities in the United States are operating with an insufficient number of refuse-collection systems. Many smaller communities depend on private and contract collection systems and have little control over the operation. The establishment of a strict formula for the operation of a refuse-collection system is impossible because of the many local conditions which affect each area differently. The necessity for a well-planned system from the public-health aspect is cited, and a sound engineering approach toward the planning and operation of such a system is presented.

474. Dumping and Landfill: Report of a Subcommittee of the Committee on Refuse Collection and Disposal of the Sanitary Engineering Division. (SA) A compilation is presented of information furnished by members of Task Committee 2 of the ASCE Committee on Refuse Collection and Disposal for the years 1952 to 1953. The nature, prevalence, operation, public-health aspects, costs, and future development of open municipal dumps are examined. Land-area requirements for dumping of ashes and street dirt are reviewed, and sanitary landfills by area-fill or trench-fill procedures are described. Depth of fill, land requirements, compaction ratio, operational procedures, equipment use, and cost of disposal are discussed.

475. Safe Loads on Dog-Leg Piles, by James D. Parsons and Stanley D. Wilson. (SM) It has been general practice to base the acceptance of steel-encased concrete or pipe piles on whether or not any part of the bottom of such piles can be seen after they have been driven. If no part can be seen, they are generally abandoned and are considered to have no presumptive bearing value. To salvage such piles the equipment described in the paper, which can be lowered into piles to measure their curvature, was devised. The paper describes several projects where such equipment was used and presents a verified, logical, analytical method of evaluating the load-carrying capacity of such piles.

476. Studies of Bearpaw Shale at a Damsite in Saskatchewan, by Robert Peterson. (SM) During the investigation of the shale at a damsite in Saskatchewan, the geology was reviewed in order to clarify the geological history of the area. The investigations included laboratory and field observations and air-photo analysis. The studies revealed the characteristics of the shale and the location and extent of slides which might have an effect on the proposed construction. However, there is still considerable cause for speculation as to the sequence and nature of the geological processes that formed the region.

477. Some Applications of Geology in Soil Mechanics and Foundation Engineering, by Parker D. Trask and H. B. Seed. (SM) The application of geologic history in the determination of subsoil profiles, soil properties, and foundation conditions is illustrated by examples from the San Francisco Bay area. Also investigated are landslides and the use of soil mechanics to explain major earth movements which might be considered geographical accidents. The application of geology in engineering construction in rocks is briefly discussed and illustrated.

478. Discussion of PROCEEDINGS-SEPARATES 192, 315, 324, 326. (SM)

479. Discussion of PROCEEDINGS-SEPARATES 188, 254, 297. (HY)

480. Discussion of PROCEEDINGS-SEPARATES 182, 198, 201, 245, 291. (ST)

481. Discussion of PROCEEDINGS-SEPARATES 208, 231, 302, 307, 336, 392, 399. (SA)

482. Equation of the Free-Falling Nappe, by Fred W. Blaisdell. (HY) A general equation for the form of the nappe is developed in the paper. The equation is not valid close to the crest but applies to that part of the nappe that is free-falling. The constants in the equation have been evaluated for the vertical, sharp-crested weir which has depths in the approach channel ranging upward from zero. The equation is verified by comparing its predictions with a number of published profiles. The comparison is excellent at the lower approach velocities and good at the higher approach velocities.

483. Flood Insurance, by H. Alden Foster. (HY) Whenever a major flood occurs in any part of the United States, much discussion arises as to why facilities are not available for writing insurance to protect property owners against losses caused by flooding of their property. The paper investigates methods of estimating flood frequencies, flood damage to property, and the average annual flood damage that may be anticipated for any property subjected to flooding. The errors of sampling involved in the statistical analysis of flood records are examined.

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